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H. B. WALKER, President RAYMOND OLNEY, Secretary-Treasurer

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The Object and Scope of A. S. A. E. Activities

THE American Society of Agricultural Engineers was organized in December, 1907, at the University of Wisconsin by a group of instructors in agricultural engineering from several state agricultural colleges, who felt the need of an organization for the exchange of ideas and otherwise to promote the advancement of agricultural engineering. The object of the Society, as defined by the Constitution, is "to promote the art and science of engineering as applied to agriculture, the principal means of which shall be the holding of meetings for the presentation and discussion of professional papers and social intercourse, and the general dissemination of information by the publication and distribution of its papers, discussions, etc."

The membership of the Society represents all phases of agricultural engineering, including the educational, professional, industrial, and commercial fields.

The scope of the Society's activities embraces both the technical and economic phases of the application of engineering to agriculture, and is comprehended in the following general headings:

(a) Farm Power and Operating Equipment—power, implements, machines, and related equipment.

(b) Farm Structures—buildings and other structures and related equipment.

(c) Farm Sanitation—water supply; sewage disposal; lighting, heating, and ventilating of farm buildings, and related equipment.

(d) Land Reclamation—drainage, irrigation, land clearing, etc., and related structures and equipment.

(e) Educational—teaching, extension, and research methods, etc., employed in the agricultural engineering field.

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AGRICULTURAL ENGINEERING

The Journal of Engineering as Applied to Agriculture

RAYMOND OLNEY, Editor

Vol. 5 OCTOBER, 1924 No. 10

EDITORIALS

Professional Progress

A DOLLAR placed at 4 per cent interest compounded annually will double in value in less than 18 years. Four per cent is considered a small return for a single year, but after all it enables the principal to be doubled in a relatively short time. This illustrates that even a small, but definite annual contribution, rightfully applied, will return one hundred per cent on the original investment. Professional standards are built up in the same way, but these rise, stand still, or depreciate in accordance with practices of those who constitute the professional investment.

High individual standards are necessary for all recognized professions. A single individual may gain fame and recognition within a relatively short time, but this is not so with professions. The growth of a profession depends upon the collective progress of a group of individuals. Thus professional responsibility is more than individual, it is likewise collective.

Each individual in a profession must accept a responsibility in professional growth. This requires the giving of service with a definite professional objective. What is your objective? Does it harmonize with the objective of your profession? A definite contribution, even though small, should be made each year to professional growth. It should be a constructive, fundamental contribution which when compared with the principal will result in a one-hundred per cent return within a reasonable time.

Such a responsibility the agricultural engineer must accept and his contributions should be regular and definite.

The American Society of Agricultural Engineers reflects the professional attitude of the agricultural engineer. What will you have it reflect? The agricultural engineer who seeks the truth in his work through fundamental thinking and exhaustive research with a directness of attack towards well-defined objectives will have no trouble in paying interest on the principal of professional standing. We owe this to the profession. Why not include it in our professional objective and then let our national society activities reflect our professional attitude? With each member doing his share our professional standards can be raised one hundred per cent within a remarkably short time.

H. B. WALKER

Boost Your Society

A PROFESSIONAL man should never lose an opportunity to boost the organization the purpose of which is to promote the interests of his particular profession. The purpose of a professional society is to bring about concerted and cooperative action on the part of members of the profession, or to do those things which cannot be accomplished through the efforts of the individual members of the profession working alone, or at least in small groups. It helps to win for the profession public recognition and standing and to uphold the rights of its members.

Applying this reasoning to the profession of agricultural engineering, there is no argument as to whether or not every agricultural engineer should support the national society which is endeavoring to coordinate the efforts of all agricultural engineers and promote development of the profession. There are perhaps a few outstanding individuals in the profession who may not be dependent upon the progress of the Society for their individual progress and development, but the progress of the rank and file of agricultural engineers is dependent to a large degree on the progress the profession as a whole makes, and which is manifested largely through the growth and activities of the organization representing the profession.

The agricultural engineer, therefore, should lose no opportunity to speak a good word for the society which represents his profession. It is particularly important that agricultural engineers who are members of that society, point out to other agricultural engineers with whom they come in contact, and who are not members, the benefits that they might expect to derive from membership.

There is both an opportunity and an obligation in connection with membership in the national society. As Theodore Roosevelt has said, "Every man owes a part of his time to the upbuilding of the profession to which he belongs." If no agricultural engineer contributed time and effort to promoting the interests of his profession, outside of his own personal interests, the advance and recognition of that profession would be very slow. But in any profession there will be found a few leaders who are farsighted enough to see that their own personal advancement depends in a large measure on the advancement of all members of the profession, or in other words, the profession as a whole. These leaders make personal sacrifices to promote professional interests and all members of the profession reap the benefit of what is accomplished through their efforts.

Where's Your Light?

"DON'T hide your light under a bushel" is an exhortation frequently used with reference to those who, by there ability or accomplishment, are in position to render to mankind a real service. If Edison had hid his discovery of the electric light under the bushel of selfishness, fear, or whatever might have impelled him not to make it known and giving mankind the benefit of his discovery, he would have rendered neither himself nor anyone a service; the benefits would have been negative.

In applying this reasoning to agricultural engineers, it is desired to point out the dangers of false modesty with respect to revealing what one may have accomplished in some particular phase of the profession. It is a fact that members of the American Society of Agricultural Engineers have undertaken and completed work of invaluable benefit to the profession at large and to the industry of agriculture served by his profession, but which is known perhaps only to a limited few. Agricultural engineers are to be commended for their hesitancy in not making public the results of incomplete investigations and researches, but it is a fact that the members of the profession are too largely guilty of hiding their light under a bushel.

If agricultural engineers could be made to realize the potential advantages to them in the way of greater progress and recognition in the profession—and incidentally greater earning power—by not being quite so modest about letting their light shine, they would perhaps get into the limelight more than they do at present.

That means making known that you are capable and willing to undertake committee assignments of particular interest to you in your engineering society, presenting papers at its meetings on valuable engineering work you have accomplished, and contributing articles on timely engineering subjects to its publication.

Economical Production of Corn in Kansas *

By W. E. Grimes

Professor of Agricultural Economics, Kansas State Agricultural College

MORE efficient production of farm products* is the most effective means of improving the incomes of farmers. In making this statement, I am well aware that other means such as legislation have been lauded as the sole salvation of the farmer. In a recent issue of a well-known farm paper, the editor expressed his lack of faith in more efficient production in the following words:

"The sad truth is that farmers as a group do not profit from increased efficiency. The individual farmer may profit from increased efficiency, but only on condition that other farmers do not increase their efficiency."

I do not share in this view and have the temerity again to suggest that, in the future, as in the past, progress will be made by increasing our efficiency and that the benefits of this increased efficiency will accrue to society as a whole as well as to groups and to individuals.

In support of this contention I wish to bring to your attention certain ways in which the farmers of Kansas have been, and still are increasing their efficiency in producing corn. The benefits of this increased efficiency are being shared by both farmers and consumers.

The economy of corn production on any farm is determined by the size of the farm, the crop and livestock enterprises combined with corn in the farm business, and the degree of efficiency attained in performing the various operations in corn production. These factors apply to corn production not only in Kansas but in all localities. Much of what is said concerning corn is equally true of other crops.

The size of the farm determines the area in corn. It also determines the sizes of fields, implements and teams. Large fields of corn can usually be produced more economically than small fields because they make possible the use of larger implements and teams which result in the accomplishment of a given amount of work with less expenditure of time and other resources than is required in smaller fields.

These conditions make production on the moderately large farms more economical than on the farm of a smaller area.

The farmers of Kansas and of other agricultural states are operating larger farms than they were a few years ago. They are thus securing the advantages of the more economical production on the larger area. In 1910 there were 177,841 farms in Kansas. By 1920 the number had decreased more than 12,500 so that in the latter year there were but 165,286 farms within the state. At the same time the average area per farm increased from 244.0 acres to 274.8 acres. This shows the tendency toward fewer farms and larger acreages per farm.

These changes in the number and size of farms have resulted in changes in the quantity of crops produced per person employed in agriculture. The 165,286 farmers in Kansas in 1920 were producing at least three million acres more of crops than the 177,841 farmers were producing i n1910. This increased production per man has been accomplished through greater use of machines and other farm investments. Larger and better machines requiring larger teams to operate them were in use in 1920 than in 1910.

These changes in the number and size of farms have not been confined solely to Kansas. The number of farms decreased from 1910 to 1920 in all of the New England, the corn belt and the wheat belt states, excepting Wisconsin, Minnesota and North Dakota. The average area per farm increased from 1910 to 1920 in every state in these groups, excepting Rhode Island, New Jersey, Wisconsin and Minnesota. This tendency toward fewer and larger farms and more machinery is characteristic of the principal agricultural regions of the United States. The average area per farm in the United States increased from 138.1 acres to 184.2 and the acreage of improved land per farm from 75.2 to 78.0 acres, from 1910 to 1920.

These larger farms and fewer farmers have been producing a greater quantity of products than formerly. Data are not available on the efficiency of farmers in producing

*Eighteenth annual meeting paper.

TABLE I. Man Labor and Horse Work Required to Perform the Operations in Corn Production on One Acre. Jackson County, Kansas, 1923.

Average yield per acre 40.7 bushels.
Highest yield per acre 53.6 bushels.
Lowest yield per acre 30.3 bushels

Operation	Man labor per acre			Horse work per acre		
	Average of 12 farms (hours)	Maximum for one farm (hours)	Minimum for one farm (hours)	Average of 12 farms (hours)	Maximum for one farm (hours)	Minimum for one farm (hours)
Plowing	3.04	7.00	1.80	12.33	23.55	9.00
Listing	1.43	1.65	1.21	5.11	6.60	3.63
Disking	.66	.93	.36	2.72	4.72	1.42
Cutting Stalks	.53	1.20	.31	1.45	2.40	.88
Harrowing before planting	.47	.72	.27	1.70	2.38	.95
Planting	1.11	1.96	.54	3.94	6.43	1.07
Harrowing after planting	.35	.78	.19	1.11	3.10	.57
Cultivating (2 rows)	.87	1.54	.69	3.46	6.30	2.76
Cultivating (1 row)	1.39	1.93	.86	2.89	3.85	1.73
Husking from standing stalks	5.58	9.01	3.64	9.84	17.21	7.28

TABLE II. Man Labor and Horse Work Required to Perform the Operations in Corn Production on One Acre. McPherson County, Kansas, 1922.

Average yield per acre 19.7 bushels.
Highest yield per acre 30.0 bushels.
Lowest yield per acre 10.0 bushels.

Operation	Man labor per acre			Horse work per acre		
	Average of 17 farms (hours)	Maximum for one farm (hours)	Minimum for one farm (hours)	Average of 17 farms (hours)	Maximum for one farm (hours)	Minimum for one farm (hours)
Disking	.54	.92	.24	2.26	5.54	2.03
Harrowing before planting	.44	.65	.31	1.85	2.60	1.39
Listing	1.28	1.97	.65	5.31	7.89	1.30
Harrowing after planting	.33	.69	.26	1.20	1.80	.84
Sledding (lister cultivator)	.84	1.62	.56	3.21	6.47	1.36
Cultivating	1.32	1.76	.89	2.52	5.10	1.78
Husking from standing stalks	5.87	12.80	3.00	8.47	13.87	5.69
Binding	1.89	3.12	1.39	5.54	9.38	4.20

specific crops as compared with previous periods in our agriculture, but the Bureau of Agricultural Economics of the U. S. Department of Agriculture reports that the efficiency of farm labor in all crop production increased 18 per cent from 1910 to 1920. The average farm worker of 1920 was producing 18 per cent—nearly one-fifth—more than the average farm worker of 1910.

This increase in the effectiveness of farm labor is due to the use of more and better machinery, the adoption of better farm practices, and the use of improved varieties of crops, better organization of the farm business, keeping more and better livestock which aid in maintaining crop yields, and in generally increased efficiency. Much of this increase in efficiency is due to the application of improved methods and practices discovered by the state and federal agricultural experiment stations. Improved machinery has also played an important part. The greater use of automobiles, trucks and tractors has contributed materially to this increase in efficiency of human effort. In Kansas the number of tractors on farms increased from 2,493 on March 1, 1915, to 24,120 on March 1, 1923.

The quantitative increase in the use of machinery between 1910 and 1920 is estimated at 46.7 per cent per acre by the Bureau of Agricultural Economics. This estimate takes into account both the increased number and the increased effectiveness of the machines.

These increases in the size of farms, in the effectiveness of farm labor, and in the use of machinery have unquestionably affected corn production. The exact effect on the economy of corn production has not been accurately determined, but it is safe to say that these influences, which find their expression chiefly in larger farms, result in more economical production of corn and other crops. The size of the unit operated by the farmer has an important effect on the economy of production, since it determines in part at least the extent to which the effect of these changes are felt on the individual farms.

The second factor influencing the economy of corn production is the combination of other crops and of livestock, which, with corn, comprise the farm business. These enterprises are related in many ways. In crop production, several crops frequently utilize the same equipment but at different seasons of the year. This is particularly true of corn and wheat in the wheat belt of Kansas. The lister, the harrow, the disk and the lister cultivator are standard equipment in corn production in that region. All of these implements are frequently used in the preparation of the seedbed for wheat. In this case the two crops are sharing the expense of maintaining the equipment. Many other expenses of a maintenance and overhead type are shared jointly by two or more of the enterprises in the farm business. This distributes these expenses over a larger quantity of product and results in lower cost per unit of pro-

(Continued on page 228.)

The more economical production of corn has come about largely through the more extensive, more efficient use of machinery

Run-off For Open Ditch Land Drainage*

By C. E. Ramser

Mem. A. S. A. E. Senior Drainage Engineer, U. S. Department of Agriculture

RUN-OFF is the basis of economical drainage design. In the absence of adequate run-off data, open drainage channels are as a rule either constructed larger than necessary or as is more often the case they are built too small. In the former case unnecessary expenditure results and, in the latter, unsatisfactory drainage.

There are so many factors affecting run-off as applicable to land drainage that it is practically impossible to devise an empirical formula for general use in drainage design. No two watersheds are alike, so that a formula used for one watershed would not apply to another without some modification. In addition to the natural factors which alone complicate the problem of run-off in its application to water power and water supply projects, run-off in land drainage is also influenced by artificially-made changes in the watercourses which tend to accelerate the velocities and thereby increase the rates of run-off. The problem is further complicated by the fact that overflows generally occur along drainage channels and a reduction in the duration of these overflows by the improvement of the channels increases the rate of run-off to be provided for in the improved channel. From the foregoing it is apparent that run-off data obtained on natural watersheds where no drainage improvements have been made would not be applicable to the same watersheds after the completion of the drainage improvements, and such data would only serve as a basis for estimating the probable rate of run-off after drainage.

Ten years ago there was practically no data on run-off from watersheds where drainage improvements had been made. During the past ten years in the employ of the U. S. Department of Agriculture I have collected considerable data on run-off in dredged drainage channels. Run-off investigations were conducted in Lee and Bolivar Counties, Mississippi, Western Tennessee, and Western Iowa. Measurements were made of the flow in twenty-two dredged ditches that furnished outlets for watershed areas ranging from 5 to 900 square miles. In connection with the run-off measurements information was obtained relating to the following subjects all of which influence or are concerned with run-off: (1) The size and shape of the watersheds; (2) the nature and amount of timber and crops; (3) soil conditions; (4) the rate, duration and frequency of rains; (5) the condition and arrangement of the water courses; (6) surface slopes of watersheds; (7) benefits resulting from drainage; and (8) flood conditions with resulting injury to crops. The importance of making a careful analysis of all factors that influence the rate of run-off for any particular watershed cannot be overemphasized. Comprehensive run-off measurements for all varieties of watersheds are much needed since a comparison of the characteristics of a watershed with those of watersheds where run-off measurements have been made, no doubt furnishes the best basis for arriving at the proper rate of run-off to be used for the project, due allowance of course being given for any differences in the characteristics of the watersheds.

To assist the engineer in his problems of run-off the results of the investigations with discussions which were made in the above-mentioned localities are here given:

Lee County, Mississippi

Run-off measurements were made on five dredged ditches in Lee County—Twenty Mile Creek, Old Town Creek, Mud Creek, Coonewah Creek, and Chawappah Creek. The watershed areas of these channels range from 56 to 140 square miles. The general characteristics of these watersheds are given in Table I. These streams lie in northeastern Mississippi. The land drained by them lies along the streams in comparatively narrow bottoms. The topography of the uplands is gently rolling, and the elevation of this land will probably vary from 20 to 50 feet above the elevation of the bottoms. The hill land is practically all cleared and in cultivation. Cotton and corn are the principal crops grown.

It will be noted from Table I that overflows still occur over the bottoms adjoining these channels. The prevalent opinion among the landowners favors moderate overflows for maintaining the fertility of the soil. In considering what size to make the drainage channels in order to reduce the overflow to a certain stage and duration, a difficult question arises as to what this stage and duration should be. Stage is less important than duration, since injury to crops depends primarily upon the length of time they are submerged. This question has been much discussed and its answer hinges upon the interdependent relation of three factors requiring consideration: (1) the reduction of injury of crops to a minimum; (2) the benefits of overflows to the land; and (3) the maximum benefits to crops obtained at a minimum expense. If overflows are entirely eliminated, the injury to crops is reduced to a minimum, but there are no added benefits to the land resulting from the fertilizing deposit left by overflows, and the actual benefits derived may or may not be in accord with the expenditures involved from the standpoint of the best investment. Again, if, for the purpose of adding to the fertility of the soil and of reducing the expense involved in the immediate removal of the water, overflows are allowed that are not particularly injurious to crops, with the possibility of an occasional overflow producing considerable damage, then the question arises as to what should be the magnitude of such overflows.

It can readily be seen from the complications existing and a lack of definite knowledge on the subject that the solution of this problem is rendered most difficult, and it is believed that for its most satisfactory solution in most cases recourse should be had to the judgment of the

*Part of the 1924 report of the A. S. A. E. Committee on Drainage.

TABLE I. General Characteristics of Drainage Areas in Lee County, Mississippi.

Creek	Watershed				Bottoms			Overflows	
						Cleared		Approximate duration	
	Area	Maximum length by channel	Average width	Average slope along channel	Total area	Before drainage	After drainage	Before drainage	After drainage
	sq. mi.	miles	miles	ft. per mi.	sq. mi.	per cent	per cent	days	hours
Twenty Mile	80	15.9	5	7	12.1	65	90	6 or 7	12
Old Town	113	28.8	3.6	4	33.0	10	65	Practically continuous overflow during rainy season.	48
Mud	100.5	31.1	3.5	5	17.1	Upper 4 miles, 60; lower, none	85		48
Coonewah	56	20.7	2.7	6	10.1	55	85	4 to 6	18
Chawappah	140	24.4	5.3	7	28.6	60	70	5 to 7	20

TABLE II. Run-off Data for Investigations in Lee County, Mississippi.

Name of Creek	Drainage area	Distance from most remote point to gaging station (D)	Time from low stage to maximum (T)	Average velocity of flow along channel (D÷T)	Run-off: Bankfull stage — Discharge	Run-off: Bankfull stage — Depth per 24 hrs.	Run-off: Estimated maximum under present conditions — Discharge	Run-off: Estimated maximum — Depth per 24 hrs.	Run-off: Estimated maximum — Water above canal bank
	sq. mi.	miles	hours	mi. per hr.	sec.-ft.	in.	sec.-ft.	in..	ft.
Twenty Mile	80	15.9	12	1.32	1900	0.88	3240	1.50	3
Old Town	113	28.8	28	1.11	900	0.30	3150	1.04	3
Mud	100.5	31.1	24	1.20	900	0.33	3250	1.20	3
Coonewah	56	20.7	16	1.29	1000	0.66	1750	1.16	2
Chawappah	140	24.4	18	1.35	2150*	0.61	4120	1.10	2

*Combined discharge for old and new channels.

people whose lands are involved. Decisions where great differences of opinion occur should be left to the judgment of the engineer. Prevalent current opinion in the vicinity of these investigations seems to favor moderate overflows.

In Table II is given a summary of the run-off measurements. In the practical application of the results of these investigations to other drainage projects with watersheds similar in size and general characteristics it appears that the two most important points to be considered are the duration of the overflow that may occur without undue injury to crops and the rate of run-off to be accommodated by the proposed drainage channel at bankful stage. The tabulated data for the streams will assist in the consideration of these points. (See Table III)

There is no apparent relation between the run-off provided for and the size of the drainage area, but it can be seen that the duration of overflow varies inversely with the amount of run-off removed. Therefore, in the design of channels for other projects where conditions permit of a direct comparison, if reclamation similar to that on Twenty Mile Creek be desired, provision should be made for the removal of 0.885 inch per 24 hours, and for reclamation similar to that on Old Town Creek, 0.296 inch per 24 hours should be removed. A ready comparison of the conditions prevailing on the watersheds can be made by reference to Tables I and II.

TABLE III. Data on Rate of Run-Off

Creek	Drainage area, Sq. miles	Duration of overflow, hrs.	Run-off removed by channel at bankfull stage in in. per 24 hrs.
Twenty Mile	80	12	0.885
Coonewah	56	18	0.665
Chawappah	140	20	0.570
Mud	100	48	0.335
Old Town	113	48	0.296

It is obvious from the above tabulated values that the best drainage conditions prevail over the bottoms of Twenty Mile Creek, and it is generally true that the landowners there are better satisfied with the benefits obtained than are the landowners on the other bottoms. It is believed that if the size of the drainage channels of the other creeks be increased sufficiently to handle a rate of run-off equal to that now provided by the channel of Twenty Mile Creek, similar drainage conditions would prevail. The bottom lands on Old Town Creek and Mud Creek would no doubt be greatly benefited by this additional provision, and there would still be overflows enough to maintain the fertility of the soil.

Bolivar County, Mississippi

In Bolivar County, Mississippi, run-off measurements were made on five dredged ditches—Bogue Phalia, Bogue Hasty, West Bogue Hasty, East Bogue Hasty and Pecan Bayou. The watershed areas of these ditches vary from 13 to 323 square miles. The general characteristics of the watersheds are given in Table IV. These streams lie wholly in the Mississippi delta and all of the land in the watersheds is comparatively flat, the average fall in the direction of the channels being about one foot per mile. The deep fertile alluvial soil of this area was deposited by overflows from the Mississippi River.

TABLE V. Summary of Rates of Run-off and Rainfall

Stream	Drainage area, sq. mi.	Run-off: At bankfull stage, inches per 24 hrs.	Run-off: At Maximum stage, inches per 24 hrs.	Rainfall: Maximum rate per 24 hrs. inches	Rainfall: Total in 48 hrs. inches
Pecan Bayou	13.0	0.32	0.66	2.08	2.93
E. Bogue Hasty	16.5	0.34	0.59	2.30	3.10
W. Bogue Hasty	24.4	0.25	0.72	2.50	3.10
Bogue Hasty	70.5	0.41	0.61	2.08	2.93
Bogue Phalia	323.2		0.37*	1.81	2.87

*4 feet below bankfull stage

The results of these investigations as compared with those made in Lee County, Mississippi, show that the rate of run-off from drainage areas is an extremely variable quantity. This variation is of course very great when comparing the low flat lands of the delta with even the ordinary hill land topography. Attention is particularly called to this fact so that indiscriminate use may not be made of the results given for these investigations. In particular data given in Table X depends largely upon the proper these results are adaptable for use in estimating run-off from the low valley lands of the Mississippi River; in general, they are applicable to all watersheds with similar characteristics.

Briefly summarized in Table V are the rates of run-off obtained for bankfull and maximum stages, and corresponding rainfall data.

The above rates of run-off for maxium stages are by no means the mamimum rates that will occur in these channels, since these rates are due to the only ordinary higher

TABLE IV. Run-off Data and General Characteristics of Watersheds in Bolivar County, Mississippi.

Ditch	Watershed: Area	Watershed: Maximum length by channel	Watershed: Average width	Watershed: Average slope along channel	Watershed: Cleared land	Run-Off: Bankfull Stage — Discharge	Run-Off: Bankfull Stage — Depth per 24 hours	Run-Off: Maximum under present conditions — Discharge	Run-Off: Maximum — Depth per 24 hours	Run-Off: Maximum — Water above canal bank
	sq. mi.	miles	miles	ft. per mi.	per cent	sec. ft.	inches	sec. ft.	inches	feet
Pecan Bayou	13.0	9.5	1.4	1.32	80	110	0.32	230	0.66	3.0
E. Bogue Hasty	16.5	12.9	1.4	1.32 upper 1.06 lower	60	150	0.34	260	0.59	2.5
W. Bogue Hasty	24.4	12.7	2.0	1.06	35	165	0.25	476	0.72	3.0
Bogue Hasty	70.5	21.6	4.6	1.06	60	785	0.41	1150	0.61	2.0
Bogue Phalia	323.2	44.0	9.8	1.06	40	5415*	0.62	3200	0.37	4.0 below

*Computed capacity, using values of slope and "n" obtained from investigations for the determination of the roughness coefficient, described elsewhere in this report.

TABLE VI. Data Pertaining to Channels and Watersheds in Western Tennessee.

Stream	Location of gaging station	Watershed: Area in sq. mi.	Length in mi.	Width in mi.	Length by channel[1] miles	Amount of dredged channels,[2] miles	Per cent in bottom land	Per cent in timber land	Average Dimensions of channel near gaging station in feet: Width: Top	Width: Bottom	Depth	Fall along channel, feet per mile: Minimum	Average
South Forked Deer River	Roberts	704	44	16	53.0	83.5	15	40	60	30	13	1.5	4.5
"	Jackson	563	34	16	42.0	60.5	15	40	55	20	10	2.0	5.0
"	Henderson	205	17	12	21.5	33.2	12	35	37	25	9.5	2.7	7.0
North Forked Deer River	Trenton	93	19	5	22.0	7.2	12	25	52	21	11	3.5	11.0
Sugar Creek	Henderson	39	10	4	12.8	2.4	10	40	22	16	7	2.2	10.0
Huggins Creek	Finger	37	7	5	8.2	10.0	12	30	26	17	6	5.3	12.0
Cypress Creek	Bethel Springs	6	3	2	3.5	1.9	10	20	25	15	6	10.6	20.0

[1]Distance from gaging station to most remote point on the watershed.
[2]Total length of dredged channel on main channel and tributaries above the gaging station.

rates of rainfall. Greater rates of rainfall have been recorded in the past, but they have not been frequent in occurence so that it is not deemed advisable to provide for them in the design of drainage improvements.

Attention is called to the difference in rates of run-off for bankfull and maximum stages as given in the above table. It is believed that, if these maximum rates of run-off were provided for at bankful stage, entire satisfaction in regard to drainage conditions would prevail. With the clearing of the rest of the timber land and interior drainage improvements a greater rate of run-off would resu t.

In view of the above it is recommended that in the design of drainage improvements the channels at bankfull stage be made adequate in size to provide for the maximum rates of run-off given in the above tables, the particular rate to be selected depending upon the similarity of the governing features.

Western Tennessee

In the vicinity of Jackson, in western Tennessee, run-off measurements were made on seven dredged ditches—South Forked Deer River, North Forked Deer River, Huggins Creek, Sugar Creek, and Cypress Creek. On South Forked Deer River measurements were made at three places—near Henderson, Jackson, and Roberts, Tennessee. The watershed areas of these streams vary from 5 to 704 square miles, and are very similar in topography to those in Lee County, Mississippi, except that several of them are very much larger.

In tables VI and VII are summarized the general data obtained. In Table VI are given the general characteristics of the various channels and watersheds upon which the correct interpretation of the run-off data in Table VII depends. From Table VII it can readily be seen that there is no definite relation apparent between the size of the drainage areas and the maximum rate of run-off in the channels, since the latter depends primarily upon the size and fall of the artificially-made channels. Where the general characteristics of the channels and watersheds are similar, small drainage areas give larger maximum rates of run-off than large drainage areas. This is exemplified to a certain extent by the maximum rates of run-off as shown in the totals for all channels across the various bottoms, with the exception of Sugar Creek and Huggins Creek. While the drainage areas of these channels are about the same size, yet the maximum rate of run-off for Huggins Creek is considerably larger than for Sugar Creek. This difference is due to different characteristics of channels and watersheds, such as the shape of the watersheds, the arrangement and fall of the channels, and the extent of the channel improvements. By reference to Table VI it is seen that the Huggins Creek watershed is shorter, more compact, and contains a greater mileage of dredged channels than the watershed of Sugar Creek. Also the channels of the Huggins Creek watershed have a greater fall and are arranged more favorably for the concentration of the run-off water. To all of the above factors may be attributed the greater rate of flow from the Huggins than from the Sugar Creek watershed.

In general it may be said that some benefit has resulted from all the drainage improvements. Quite satisfactory drainage has been secured on the North Forked Deer River above Trenton and on Cypress Creek above Bethel Springs. Since construction both of these channels have greatly enlarged through erosion. The channels of the South Forked Deer River and tributaries above Pinson are giving only fairly satisfactory drainage, but if they are kept free from vegetation and other obstructions it is likely that their capacities will be appreciably increased through the agency of erosion. The drainage conditions on the South Forked Deer River from Pinson to Roberts are far from satisfactory and it is believed that the process of erosion in this section of the river will be too slow to relieve the situation to any appreciable extent in the near future. (Pinson is located about half way between Jackson and Henderson, Tennessee, the drainage areas at these points being given in Table VI.)

In making use of these run-off data, in the design of drainage improvements, it is necessary to consider carefully all the general characteristics of the watersheds and channels. For example, the difference in the rates of run-off for Sugar and Huggins Creeks, as it is discussed in the foregoing, was found to be due to a dissimilarity in the watersheds and channels. In addition to the above considerations it is absolutely essential that conditions per-

TABLE VII. Run-off Data for Investigations in Western Tennessee.

Stream	Station	Drainage area in sq. mi.	Run-off: Dredged Channel: Bankfull Stage: Sec. ft.	Bankfull Stage: Ins. per 24 hrs.	Maximum Stage: Sec. ft.	Maximum Stage: Ins. per 24 hrs.	Max. through all channels across bottom: Sec. ft.	Ins. per 24 hrs.	Rainfall for max. rate Run-off: Max. rate, ins. per 24 hrs.	Total amt., ins.	Duration in days	Depth of water over ditch bank, ft.	Duration of over-flow	Date of max. stage	Rainfall stations
South Forked Deer River	Roberts	704	2220	0.117	3515	0.186	[1]		No complete record			2.8	No record	1-25-16	
"	Jackson	563	1215	0.080	1575	0.104	5790	0.383	1.52	3.69	5	2.0	6 ½ da.	4-7-17	Jackson; Henderson
"	Henderson	205	982	0.178	1445	0.262	2800	0.51	2.12	3.04	2	2.5	2 ½ da.	4-24-17	Henderson; Finger
North Forked Deer River	Trenton	93	1785	0.715	1935	0.775	[2]		1.80	2.20	2	0.5	18 hrs.	4-2-17	Trenton; Milan
Sugar Creek	Henderson	39	430	0.410	640	0.61	1120	1.07	2.12	3.04	2	1.7	2 days	7-23-17	Henderson; Finger
Huggins Creek	Finger	37	500	0.502	875	0.88	1410	1.42	2.00	3.10	2	2.7	2 days	7-23-17	Finger
Cypress Creek	Bethel Springs	6	430	2.670	430	2.67	430[3]	2.67	4.25	4.25	1	0.0	2 hrs.	7-23-17	Bethel, Springs

[1]No measurements were made.
[2]Nearly all water was carried by dredged channel.
[3]All water was carried by dredged channel.

TABLE VIII. Summary of Run-off and Overflows in Western Tennessee.

Stream	Drainage area, sq. miles	Run-Off: Bankfull stage, ins. per 24 hours.	Run-Off: Maximum through all channels across bottoms, ins. per 24 hours.	Duration of longest overflow, during period of these investigations, days.	Number of overflows lasting 24 hours or longer
South Forked Deer River at Jackson	563	0.080	0.383	6½	9
South Forked Deer River at Henderson	205	0.178	0.510	2½	9
North Forked Deer River	93	0.715	0.775[1]	18 hrs.	None
Sugar Creek	39	0.410	1.07	2	5
Huggins Creek	37	0.502	1.42	2	3
Cypress Creek	6	2.670	2.76	2 hrs.	None

[1]Run-off for maximum stage in dredged channel.

taining to disastrous floods and moderate overflows be known. Other things being equal, for two watersheds, the greater rate of run-off will be found for the watershed where the least overflow occurs. In drainage design preference should be given to the use of run-off data obtained for streams where satisfaction prevails in regard to overflow conditions. Unfortunately such data are very meager and consequently it becomes necessary to resort to the use of th e"next best" available data.

Table VIII was prepared to summarize briefly and show the relation between the run-off and overflows for various streams with the exception of the South Forked Deer River at Roberts for which it was impossible to make run-off measurements across the bottom during flood stages. The number of overflows lasting 24 hours or longer is given in the last column. Overflows lasting only 24 hours are not considered as a rule to be very injurious to crops. Under certain conditions, however, disastrous results sometimes follow a 24-hour overflow; for instance, where a field of corn is totally submerged, followed by a scorching sun after the flood subsides. Hence there is still an element of some uncertainty in raising crops where 24-hour floods are apt to occur .

In the third column of Table VIII are given the rates of run-off in the various channels at bankfull stage. In the next column are given the maximum rates of run-off flowing down through the bottoms during overflows, as measured at all channels through the levee roads across the bottoms. It is believed that, if the channels were made large enough to remove at bankfull stage the rates of run-off as given in the fourth column, no overflows of more than 24 hours duration would occur, unless due to extraordinary heavy rains. In the application of the results of these investigations to proposed drainage projects, a careful comparison of the data contained in Table VI with similar data pertaining to the proposed projects should be made.

Western Iowa

Run-off measurements were made in western Iowa on five dredged channels—Boyer River at Dunlap, Boyer River at Missouri Valley, Willow Creek, Allen Creek, and Pigeon Creek. The drainage areas of these ditches range from 59 to 900 square miles. In general characteristics of the various watersheds are about the same, except that the percentage of bottom land for the Allen Creek watershed is considerably greater than for the other watersheds. It is estimated that the amount of timber land scattered over the watersheds is about five per cent of the total area. This land consists of groves of trees with underbrush and scrub oaks principally located along the old winding, abandoned channels of the streams. A few areas of virgin timber are to be found on the hill tops and slopes. In general it may be said that the amount of scattered timber over the watersheds is not sufficient to produce any appreciable effect upon the run-off. Large areas on the watersheds are devoted to pasture. The principal crops are corn, wheat, oats, and hay. Erosion is quite actively proceeding over all of the uplands, evidence of which may be seen in the flood waters of the streams that are heavily laden with silty soil and by the deep gullies that are formed on the slopes of the fields. Also the surface soil on the slopes is much lighter in color where erosion has taken place and the richer and darker parts of the surface soil have been washed away. The soil and subsoil over the various water-

TABLE IX. Data Pertaining to Channels and Watersheds in Western Iowa.

Name of stream	Watershed: Area in sq. mi.	Watershed: Length in miles	Watershed: Average width, miles	Watershed: Bottom land in per cent of total area	Approx. distance from gaging station to furthest point on watershed by channel, miles	Length, of main dredged channel in miles	Fall of channel near gaging station in ft. per mile[1]	Average dimensions of channel near gaging station: Top width, feet	Bottom width, feet	Depth, feet[2]
Boyer River at Missouri Valley	900	84	11	12	168	38.5	2.0	80	42	12
Boyer River at Dunlap	654	60	10.5	10	142	12.0	3.5	93	45	18
Pigeon Creek	148	34	4.5	13	70	12.5	3.5	43	18	10
Willow Creek	143	37	4.0	20	80	5.5	1.5	47	25	7
Allen Creek	59	23	2.5	31	45	10.5	1.5	40	12	6.5

[1]This is taken as equivalent to the fall of the water surface at a high stage.
[2]Depths are taken below the average elevation of adjoining land.

TABLE X. Summary of Run-off Measurements in Western Iowa.

Name of stream	Gaging station near	Drainage area, sq. mi.	(1) Bankfull Stage: Gage height, feet	Bankfull Stage Run-Off: Second feet	Bankfull Stage Run-Off: Inches per 24 hours	Maximum Stage: Gage height, feet	Maximum Stage: Date	Maximum Stage Run-Off: Second feet	Maximum Stage Run-Off: Inches per 24 hours
Boyer River	Missouri Valley	900	11.3	3630	0.15	13.5	6-4-17	4955	0.205
Boyer River	Dunlap	654	18.6			15.2	6-9-17	4450	0.253
Pigeon Creek	Crescent	148	10.0	1870	0.47	14.0	6-4-17	3925	0.760
Willow Creek	Missouri Valley	143	9.5	940	0.245	10.6	6-4-17	1517	0.395
Allen Creek	Missouri Valley	59	8.0	749	0.472	8.8	6-4-17	930	0.586

(1) By bankfull is meant a stage equivalent to the average elevation of the adjoining land.

sheds are capable of absorbing large quantities of water. Owing to this condition of the soil and to the large percentage of the land that is cultivated, the percentage of the rainfall that runs off during a growing season is very small. The topography of the upland varies from undulating to rolling and rough. The valley of the Missouri River through which the lower ends of all the streams flow is comparatively flat and is sharply bordered with steep slopes and bluffs ranging in height from 100 to 300 feet. The elevation of the Missouri River valley is about 900 feet above sea level and the elevation of the upper end of the Boyer River watershed is about 1400 feet above sea level. There are a number of small lakes or rather marsh areas located near the divides of the various watersheds.

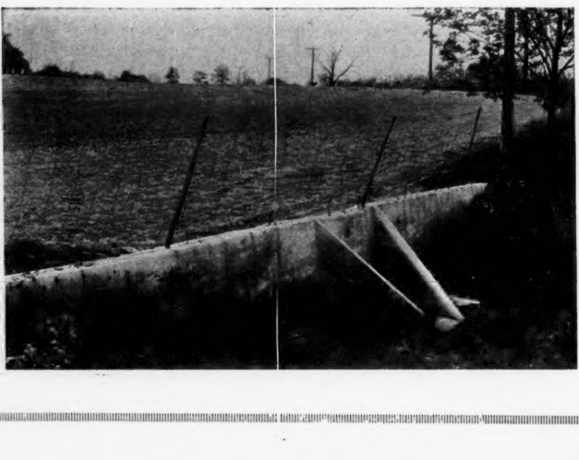
A general summary of the data obtained is given in Tables IX and X. A correct understanding of the run-off study being made of the information pertaining to the channels and watersheds as contained in Table IX.

The shape of all the watersheds is about the same, that is, they are long and narrow. It is also true that the topography of that part of all the watersheds lying above the Missouri River bluff line is practically similar. The chief difference in the watersheds that affect run-off are in the sizes of the drainage areas, the amount of dredged and old channel, the amount of bottom land in per cent of the total area of watershed and whether the dredged channels lie in the narrow river bottoms or in the Missouri River bottom. The amount and duration of rainfall are important factors to be considered in a comparative study of the rate of run-off from two areas. Other things being equal, small areas have larger rates of run-off than large areas per square mile of drainage area, since the former are affected by short rainfalls of great intensity, while the latter for their maximum flow depend upon the longer rains of less intensity. If only the sizes of the drainage areas were considered the rates of run-off as obtained for Pigeon, Willow and Allen Creek would not conform to the above principle. Referring to Table X it is seen that while the drainage area of Allen Creek is much smaller than that of Pigeon Creek, yet the rate of run-off in inches per 24 hours is much smaller for the former than for the latter. This is also true for Pigeon and Willow Creeks although their drainage areas are more nearly the same size. Thus what appears to be an apparent discrepancy may be attributed to a number of things: (1) Pigeon Creek has a greater mileage of dredged channel than either Allen or Willow; (2) the dredged channel for Allen and Willow Creeks lies wholly in the Missouri River bottom, whereas nearly all of the dredged channel for Pigeon Creek above the gaging station lies above the Missouri riven bluff line so that it has a steep slope and collects the run-off rapidly from the rolling watershed of the upland; and (3) Pigeon Creek has a smaller percentage of bottom land than either Allen or Willow. The first and particularly the second of the above factors no doubt contribute largely to the reason why the greatest rate of run-off per mile of drainage area was found for the Pigeon Creek watershed. The above discussion serves to emphasize what might happen in the way of an increased rate of run-off if the dredged channels of either Allen or Willow Creeks were extended up into the valley of the hill lands. In conclusion attention is especially called to the fact that in applying the results of run-off given in Table X to proposed drainage projects on other watersheds, a careful comparative study of all the characteristics of the watersheds that influence run-off should be made. A rather common practice which should be discouraged is to consider simply the sizes of the drainage areas. For example, if this practice had been followed in the design of the Pigeon Creek Ditch by using the rate of run-off obtained for Willow Creek provision would have been made for only a small part of the maximum rate of run-off.

General Discussion

While any enlargement whatever of natural channels, or the construction of new channels, will in most cases reduce the height and duration of overflows and thereby improve drainage conditions to a certain extent, yet destructive floods still might occasionally occur which would make the successful raising of crops a matter of much uncertainty. In order for a drainage improvement to be the most effective, it must be adequate. In many instances the sizes of drainage ditches have been determined by the amount of money that the landowners were willing to invest. In a few cases where the magnitude of drainage works has been governed by such a procedure the results have been successful, but much more commonly the improvements prove wholly inadequate with the result that partial or complete crop losses occur. The consequence is that a general disheartening of the farmers takes place and often the practice of drainage in the vicinity either falls into disfavor or is thoroughly but justly condemned. Even where engineers and country surveyors have been in charge many ditches have been planned and constructed without a knowledge of the size of the watershed area to say nothing of the probable rates of run-off. While a knowledge of the size of the watershed area is indispensable to drainage design yet the inadequacy of many drainage improvements demonstrate clearly that many other important characteristics of the watersheds should be carefully considered as has been discussed in the foregoing investigations.

The only certain remedy for poor drainage lies in carefully planned systems based on adequate run-off data. It is true that some benefits result from nearly all drainage improvements, but the largest and surest return on the investment comes only from the properly planned improvement based on thoroughly practical and economical methods.



THIS picture shows a good example of the practical application of engineering to agriculture. In this case the farmer has erected a concrete dam and tile outlet to prevent the field from washing. Soil erosion is one of our big agricultural engineering problems, and agricultural engineers are making real progress toward its solution. The next problem will be to get farmers to apply the solution the engineers have worked out. This may be considered a part of the engineer's job too; it is a good example of how closely engineering and economic considerations are interrelated.

Does the Battery or the Unit Determine the Size of a Farm Electric Plant?

By William Menzies

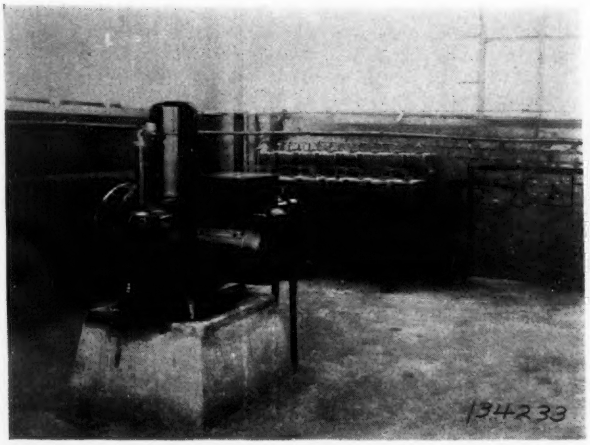
Engineer, Westinghouse Electric and Manufacturing Company

THERE are three general types of farm electric lighting plants as regards the part which the battery plays in operation. In the first, or fully automatic type without battery, the unit is cranked automatically by a small automobile battery, and energy is furnished direct from the unit. In the second, or fully automatic type with battery, the battery supplies the lighter loads and when the load exceeds a predetermined amount the unit starts automatically and helps out. In the third type the battery supplies the load except at such times as the unit is started by hand to help out on the very largest loads.

In the first type of plant the unit is the plant and it must be capable of supplying the maximum load. Both the engine and generator are capable of carrying a small overload for a short time. Since the unit must operate whenever energy is required and since the efficiency of both the engine and generator is low at light loads, it is best suited to garages, schools, churches, etc., where the load is more nearly constant than in a residence. In many cases the load is of such a character that a plant of this type, without the automatic feature, is thoroughly practical. In churches, construction camps, etc., the load is almost entirely lamps and usually the load is wanted for a reasonably long and well-known period of time, so that it is not irksome to have to start the unit manually.

The capacity of the second type of plant is the combined capacity of the unit and battery. In this type of plant as well as the first it is almost essential that gasoline be used for fuel and automatic operation without frequent servicing is not easily accomplished. The second type of plant does not take into account beforehand the duration of the load in excess of the battery capacity, and, as a result, the unit is started when such a load lasts for a very short time.

The capacity of the third type of plant is the combined capacity of the battery and the unit. It is obvious, however, that this statement is somewhat misleading because a plant of the second type without the automatic feature would not be suitable for most applications. It would be unreasonable to expect one to start the unit manually each time it would normally have been started automatically.



A standard battery type of farm electric plant consisting of a 750-watt generator and 4500-watt-hour battery

Besides one would not always know when an extra load such as an automatic water system would come on.

A very high percentage of the plants in operation are of the third or battery type with the unit started manually, and this discussion will have especial reference to this type. Such a plant is made up of two distinct units, which have different but well-defined characteristics. The unit may operate to charge the battery only, or it may charge the battery and furnish energy, or both the battery and unit may furnish energy in case of heavy load. The capacity of the unit is very definitely limited, and this is materially reduced if the engine has leaky valves or rings. The friction, windage, and constant losses of the unit are a goodly percentage of the total output, and this accounts for the poor economy that accompanies a lightly loaded unit.

The battery, on the other hand, is capable of handling large loads for a short time and smaller loads for a longer time; it will stand for a long time without appreciable loss of its stored energy and has a slightly higher efficiency, the smaller the load taken from it, which is just the opposite of the unit in normal operation. These characteristics make a battery very desirable where the load is so variable as is common in the average application.

The question of whether the capacity of the unit or the battery is more important naturally presents itself. Experience has shown that users are naturally loathe to give plants frequent attention. The average user is willing to start up the unit to relieve the battery of the ironing load and to charge the battery at the same time; also if a special social function requires the use of an abnormal amount of power, the unit is operted. It is evident that if the unit is called upon to help out only on the largest loads, it is the battery capacity which really determines the size of the plant as the automatic water system and the time clock to illuminate the hen house may both be on while there is a considerable load in the home, and this may constitute a very heavy load for the plant, and it would be ridiculous to expect one to operate the unit every time the hen house is illuminated, and since the water system operates at irregular intervals the battery capacity should be such that it is able to take care of this condition without assistance.

The farm lighting plant is practically a battery plant with a unit for charging it, and the unit which will charge it must economically is the proper one to use. Of course, there are conditions where the combined rating of the plant and battery is of great importance and the rating of the unit then is not to be overlooked. The time required for charging a battery is dependent upon the rate of charge, but regardless of its capacity, there is a limit to which the time required for charging a battery can be reduced. If a relatively large unit is used, the point of gassing is reached earlier in the charge and poor economy begins at this point regardless of whether the unit is governed or not. If a smaller unit is used to charge the battery, the point of gassing is delayed and the battery may be charged with better economy than in the former case.

In the case of most machinery one is vitally interested in the rating such as tons per hour of a silo filler and bushels per hour of a grain grinder, but when one buys a lighting plant he is buying lighting service, and since the battery gives this service independent of the unit more than 90 per cent of the time, the battery rating is of prime importance. In fact, the battery size should be determined by the conditions to be met and then the unit should be

selected with the idea of properly charging the battery. The user is very apt to be misled if too much stress is laid on the rating of the unit. There are cases of users having had plants too small for their needs and in buying a second time have gotten plants with a greater combined rating but with batteries smaller than before, with the result that they were much worse off than before.

Much trouble comes from attempting to use too small a battery. First, there is the annoyance of having to charge very frequently. Second, the life of the battery in proportion to the cost is very much reduced. Third, it is very difficult to charge the battery without having the lights on at the same time with the accompanying rapid deterioration due to excessive voltage variation. Fourth, a general lack of reliability due to insufficient reserve capacity.

In a well-proportioned farm lighting plant the unit is nearly always operated to help out not because the load on the battery would be unduly destructive, but because it is much more economical to get the energy direct from the unit and to save the wear on the battery.

Plants of the purely farm lighting type have been considered above. If a unit is supplied with a pulley or if considerable demand for power is to be made such as would be the case if a milking machine is operated daily from an electric motor, then the rating of this unit is important. From this it is seen that no definite rule can be laid down, especially when applications vary so widely. In the great majority of cases, however, it is evident that the battery size establishes the real capacity of the farm lighting battery.

* * *

There are a number of things which will determine the success or failure of a farm electric plant, not the least important of which, by any means, is the size of the plant. One of the most serious mistakes a farmer can make is to purchase a plant that is too small to meet his requirements. In making an analysis of his requirements he may think that the size he has chosen is adequate, but usually he discovers more uses for electricity than he had anticipated. Consequently the size selected should be plenty large enough.

Economical Production of Corn in Kansas

(Concluded from page 221.)

duct. This, of course, gives more economical production of corn, or of any other product.

The effect of a desirable combination of enterprises on such costs may be illustrated by data from the farm organization studies of the Kansas agricultural experiment station. The average cost per hour of horse work on 22 farms in Jackson County in 1921 was 13.9 cents per hour. One of these farms had a cost of 7.6 cents per hour. This farm had a desirable combination of enterprises which kept men, horses, and machines well occupied throughout the year. The horses on this farm averaged 4.3 hours of work per work day. Another farm in this group had a cost of 23.4 cents per hour of horse work. This farm had a less desirable combination of crops and livestock and therefore could not keep its horses and equipment so well occupied. The horses on this farm worked less than two hours per day.

The cost of the use of a lister illustrates the same point. The average annual cost of the use of a lister on these farms was $5.68. The average annual use per lister was 44 hours and the average cost per hour of use was 13 cents.The use per lister varied from 4 to 240 hours during the year and the cost per hour of use varied from 2 cents to $1.42 per hour. The farms having the greater use for the machine had the lower costs and the more economical production.

Similar results could be given for other years and for other sections of Kansas but they would merely illustrate further the principle involved, which sithat the farm with the better diversity of combination of enterprises can utilize its resources in production more effectively and more economically and consequently will have the more economical production.

The third phase of the problem of economical crop production pertains to the efficiency of conducting the operations connected with each crop. The efficiency of man labor and the effectiveness of horse work and of machines used in the business are in part determined by the size of the farm and the combination of enterprises and in part by the skill of the management in directing operations. If advantage is taken of those practices which result in high yields without materially increasing costs, much more economical production will be secured. High yields are usually secured at lower costs per bushel or ton than low yields. Combining livestock with crop production aids in maintaining yields and keeping costs down.

There is abundant opportunity for improvement in corn production in Kansas. This is well illustrated by the man labor and horse work required to perform each of the usual operations in corn production on a number of farms —in Jackson (Table I) and McPherson (Table II) Counties, Kansas. These data are from the farm organization studies of the Kansas agricultural experiment station. The average as well as the maximum and minimum requirements for these farms are given in these tables.

Jackson County is in the northeastern or corn belt section of Kansas. In this county the usual yields of corn are 25 to 35 bushels per acre. McPherson County is in the wheat belt where the corn crop is less certain and the usual yields of corn are 15 to 20 bushels per acre. In this latter area larger machines are used and the methods employed in the production of corn are, in general, more extensive than in Jackson County. For example, in McPherson County most of the corn is listed without previous preparation of the soil. Cultivation consists of one harrowing followed by "throwing out" and then "throwing in" with a lister cultivator, and a last cultivation with a shovel cultivator.

It will be noted that there is a wide range in the labor and horse work requirements for each operation. These variations can be accounted for by one or more of the factors which have been mentioned as influencing the effectiveness of production. In some cases high requirements are due to small farms, small fields, small implements, few horses in teams, and in some instances to inefficiency on the part of the operator. The wide variation indicates the opportunities to improve production through securing those conditions which result in the most efficient production. From these figures it is possible to establish standards which farmers can reasonably expect to attain.

Corn production in Kansas is becoming more efficient because of (1) larger sizes of farms; (2) greater effectiveness and quantity of machinery; (3) better combination of enterprises, giving better diversity of business and more economical production; (4) the use of better methods and practices; (5) the introduction of improved varieties of corn; (6) the use of larger teams and larger machines in larger fields; (7) and a general increase in the effectiveness of farm labor in corn production. There is still abundant opportunity to increase the economy of corn production on many Kansas farms. The problem on these farms is to adopt these proven practices, methods, and improvements now followed by the more efficient producers.

(EDITOR'S NOTE: In Prof. Grimes' summary of the factors contributing to the more efficient and economical production of corn in Kansas, it must be perfectly obvious to the agricultural engineer that the application of engineering to the problem is by far the most important factor entering into its solution. Such discussions also furnish additional proof that the strictly engineering phases of the problem cannot be separated from the economic and management phases. Economics, engineering, and management are so closely related that a consideration of one in connection with any particular problem is not complete without the other. The agricultural engineer, therefore, in addition to training himself along engineering lines, must also prepare himself to handle just as effectively problems in agricultural economics and farm management.)

Fire Resistive Construction as Applied to Lumber Built Farm Structures *

By Theodore F. Laist

Member A. S. A. E. Architectural Adviser, National Lumber Manufacturers' Association.

IT is not generally realized that progress in the direction of better and more efficient utilization of lumber in the field of building construction has kept pace with the progress so noticeable in connection with some of the newer building materials. In the field of research the U. S. Forest Products Laboratory and other institutions of learning, with the co-operation of lumber trade associations, have made valuable contributions to the lore of this old and most valuable material. But useful as these investigations have been, none of the results have been sufficiently spectacular in character to appeal to the popular fancy and to receive more than passing notice. Thus while such information has been placed in the hands of the building specialist much remains to be done to inform the man in the street.

Research in lumber has generally been directed towards the more effective treatment for prevention of decay, kiln drying, utilization of wood wastes, substitution of species, and exhaustive tests to justify higher stress values for some species. Coupled with the study of these topics are the investigations along the lines of fire prevention and the reduction of fire hazards fostered by individuals and associations more directly interested in the production of lumber.

The occasional outcry against fire waste and the beneficial results of the annual fire prevention week are small compared with the calm and deliberate study and promotion of methods which reach the fundamentals of the fire hazard problem.

The varied propaganda in the field of building material has brought out the important fact that, notwithstanding the hazards of and the losses due to fires, there are to be found no substitutes for many uses for the so-called combustible materials, particularly of lumber. What then is the next logical step to be taken by those intent on furthering better construction? Obviously, the more scientific and better utilization of the materials at hand with a view to minimizing the fire hazard.

Much can be done to accomplish this result, and in three different ways; first, by the adoption in their entirety of those principles upon which so-called mill construction is based, a type of construction which finds its principal applications in industrial buildings; secondly, a partial adaptation of the principles of major importance, particularly those pertaining to the avoidance of concealed spaces and ducts, carrying with it fire-stopping and the avoidance of small members wherever practicable; and third, the limited use or employment in extra hazardous positions of fire-resistive construction, which consists of the employment of wood covered with a material which offers resistance to fire, as, for example, metal lath and plaster.

Of the first type little need be said. The principles of mill construction are well understood. In Europe they have been practiced for centuries, although they may not have been formulated. The practice of using thin members is one which has developed in our own country, especially in the West. Timber has been used since the beginning of civilization and many of the architectural monuments that have been passed down to us by preceding generations are largely of this material. We need but to point to the wonderful half-timber buildings of the middle ages, many of which are standing today. In these the wall construction, as well as the floor beams, are of timbers of large section with the air spaces filled with sand or other incombustible material. Air channels and concealed openings are always carefully closed. The result is that European cities are not often visited with such disastrous conflagrations as from time to time arouse our attention in this country. In the matter of pure design, other than the more scientific differentiation between grades and species in their utilization, we can hope to accomplish little more than has been done by the designers of the middle ages. We cannot hope to improve upon the wonderful designs of timber trusses with which the minor English churches were embellished, and nearer home we find our own colonial and early American work. So that in our search for progress we must look for newer fields and they lie in the direction of safer construction generally, and in fire-resistive or slow-burning lumber construction.

The principles which underlie mill construction insofar as they affect the employment of lumber ar these: The avoidance of concealed air spaces, the use of timbers of large cross section, and the avoidance of excessively large floor areas without the intervention of fire walls.

When we review the early history of frame construction in this country we find that the tendency in design was in the direction of what is now known as "slow burning" or "mill construction." The important basic principle of this type of construction is that of the employment of timbers of large section, which was the feature of early barn and other braced-frame structures.

The mill type of construction is generally accepted as one of superior qualities and offers no greater hazard than so-called fireproof construction, in fact when buildings so constructed are sprinkled they obtain the same insurance rating as if fireproof. The employment of the principles which underlie slow burning construction have never been extended to dwellings and farm structures. In fact, in the more recent structures the reverse is true. In our early history, barns and the larger farm structures were constructed of heavy timbers.

Although the resistance heavy timbers offer to fire is well known, few of us appreciate the terrific heat a 12-by-12-inch timber will withstand for an hour without being consumed to the point of failure. We fail to differentiate between large timbers and lumber of small cross section, notwithstanding the fact that wood piled up with air spaces intervening and a large log are as different in their resistance to fire as steel is from wood. It is almost impossible to start a fire excepting at the edges of a heavy timber, for which reason they are chamfered or rounded. Likewise, it is difficult to start a fire on a solid plank floor. These attributes of wood are taken advantage of in the design of lumber mill construction.

In column tests conducted by the Board of Fire Underwriters in 1919 the following results were obtained:

Unprotected timber columns failed in from 35 to 45 minutes while loaded with sustained load during the test of 118,500 pounds. Unprotected steel columns, under practically the same loading, failed in from 11¼ to 21½ minutes. Cast iron columns in from 21½ to 34½ minutes; and round cast iron columns filled, in 45¼ minutes; and steel pipes concrete filled in 36 minutes.

In the application of these underlying principles of mill construction to farm structures little headway has been made; in fact other requirements have been so uppermost in the mind of the average designer that the important quality of

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fire-resistive construction has been somewhat overlooked. Thus we see the braced rafter plank barn coming very much into vogue, and with good reason, but the weakness of this type of barn as compared with the old style of heavy timber barn from this point of view is to be found in the multiplicity of small members, the failure to shut off by fire stops the lower floor from the haymow, and similar tendencies. On the other hand, the ease and speed of construction due to the light trusses are good reasons for its popularity.

Plans for this type of barn are available through many of the agricultural college extension services, state departments of agriculture and lumber service bureaus. The merits of this type are succinctly detailed in a bulletin I have at hand, as follows:

"In contrast with the old clumsy timber barns we have the modern plank frame barns. The framework of these barns is constructed entirely of 2-inch planks. The amount of time, labor, and lumber necessary to erect one of them is appreciably less than for a timber-frame barn of the same size. If correctly designed and constructed they are stronger than the timber barns. There are several different types of plank-frame barns, the most popular types being the braced rafter or balloon frame, the Shawver truss, and the Gothic roof."

While the advantages enumerated are apparent and should not be lost in the design, it may be suggested that under certain conditions some concessions might consistently be made to effectively overcome fire hazard by such simple means as the combination of several trusses. Increasing the span may require heavier roof sheathing or purlins, or even a laminated type of roof construction. In order to avoid difficulty of handling and expense of timbers of large section the trusses might be built up of planks.

Likewise, in the floor of the haymow the laminated type of floor construction, consisting of 2-inch planks, on edge closely laid, might well be substituted for the 2-by-10-inch joists, making an effective stop against the spread of fire. A laminated floor constructed of 2-by-4-inch members with a span of twelve feet would be safe for a live load of over 150 pounds per square foot.

In the laminated or Gothic type of roof construction, there are fewer members, less timber, and less bracing. The scope of this paper does not permit entering into any extensive discussion of details of construction. My only purpose in mentioning these particular examples is to endeavor to turn the thoughts of the designer of farm structures into channels so that along with other requirements of barn structures greater consideration may be given to the features of construction under discussion.

Fire stopping is one of the essential features of the second type of construction. It has been shown that fires do not spread always through ignition by contact with a flame, but often through the accumulation and ignition of combustible gases, in parts of the structure far removed from the place of the fire's origin. These gases generated often by a small fire within a restricted area frequently spread through ducts, openings, and cracks which have no reason for being and which are accidental, due to carelessness in design and construction. Their elimination is the purpose of fire stopping. The phenomena of many fires almost simultaneously starting in several places of a structure is thus accounted for. In the fire of the Chicago, Burlington & Quincy office building in Chicago, a high building of the most modern type, fire was communicated to the contents of some of the rooms by an adjoining fire which was exceedingly hot. The combustible furnishings on some of the floors were entirely consumed, as may be supposed, but in the lavatories which contained no combustible material whatsoever and which were separated by halls and metal doors, the marble in many instances was found to have been calcined and the metal work entirely melted, although nothing in the room itself was combustible. This is a case in which the destruction was due entirely to combustible gases communicated from a distant part of the building where the fire raged.

Such instances as these emphasize the importance of fire stopping, the avoidance of such spaces as we find around the end of the joists resting on a ribbon in balloon construction, and the almost invariable connection between the cellar or attic and the spaces between the studding in cheap house construction. There are a number of vulnerable points in house construction, the danger of which may be overcome by the insertion of wood blocking, metal lath, or brick and mortar laid on wood supports. On the care with which this is done and the avoidance of cracks and openings depends the efficiency of the fire stop.

Now we come to the third method and one which is the outcome of some more recent tests of the underwriters' laboratories made in Chicago. One of the important essentials of a mill construction building is the curtailment of large floor areas. The standard fire wall as prescribed by the underwriters is a brick wall, ordinarily not suitable, not only on account of cost but for other practical reasons as well.

These tests have successfully consummated the long quest for an economical type of construction which would provide an inexpensive means of adequate fire protection suitable for the average farm structure or home.

One set of tests was made on partitions constructed of wood studs, metal lath, and gypsum plaster; and the other on a floor of the ordinary type of joisted construction. The test to be regarded as successful was required to withstand safely the fire test for one and one-quarter times the period for which the classification was desired; secondly, to withstand the fire stream test; and third, that no flame shall have passed through the partition during the prescribed fire period. The transmission of heat through the partition during the prescribed period shall not have been such as to raise the temperature on its outer surface in excess of 300 degrees Fahrenheit, and finally, the partition shall not have been warped, bulged, or disintegrated under the action of the fire or water to such an extent as to be unsafe.

Inasmuch as the classification asked for metal lath protected lumber was one hour, the fire was in one test to be continued for not less than one hour plus twenty-five per cent, or one hour and fifteen minutes, and the fire stream in the second test was applied at the end of forty-five minutes.

The first partition test was made on a full sized panel ten feet wide by eleven feet high, plastered on both sides with three coats of gypsum plaster three-quarter inch thick. Observations were continued for three hours and one and one-half minutes, at the expiration of which the fire passed through the partition which was then withdrawn from the fire.

In the second test the fire was extinguished at the end of the seventy-five minute period. The highest temperature on the unexposed surface was 176 degrees Fahrenheit at sventy-five minutes and not a single crack or crevice appeared on the plaster face and the standing finish was unimpaired without mar or stain. Despite the fact that during a good part of the test the flames were impinging directly on the plaster finish, the depth of the charring on the studs ranged from a mere discoloration to 5/16 inch near the middle of the sample, while in most cases the studs were not discolored.

The floors used in the test were of ordinary wood joisted construction, 2-by-10-inch yellow pine joists spaced 16 inches on centers with a clear span of about thirteen feet cross-bridged at the center. Rough pine flooring with a nominal thickness of ⅞ inch was nailed to the upper side of the joists and covered with Cabot's Quilt lapped about three inches at the edges. Over the quilt and parallel to the joists 2-by-2-inch wood sleepers were nailed to the rough flooring at about 16-inch centers. After that a 1-by-4-inch piece of dressed and matched pine, finished floor was blind nailed to the sleepers. The under side of the joists was metal lathed and plastered with gypsum plaster.

The test on the floor to be regarded as a success was to meet two conditions, one that the floor shall have sustained safely the full-rated safe-working load during the fire test without passage of flame for a period equal to one and one-quarter times that for which the classification was desired. which was one hour in this case; and the second condition to be met was that the floor shall have sustained safely the

full safe-working load during the fire stream test and after its completion shall sustain a total load equal to the dead load plus two and one-half times that of the live load for which the construction was designed.

After the test and the removal of the load it became evident that, with the exception of a few discolorations, the top of the finished floor showed no trace of fire, nor did the furring strips or the Cabot's Quilt show any traces of fire. The removal of the rough floor showed considerable smoke stain but only the undersides of the joists were charred, ranging from practically nothing to a maximum of about 5/16 inch. The small loss in effective cross section was negligible.

CONCLUSIONS

This construction having thus successfully met the requirements for durability, strength, fire-retarding properties and stability specified by the conditions of the standard fire test, the fire council of the Underwriters' Laboratories approved the recommendations of its engineers and on November 8, 1922, awarded a one-hour rating to the metal lath protected wood studded partitions and, likewise, accorded a wood joisted floor, protected on the underside with metal lath and plaster, the full hour rating. In this connection Mr. Dana Pierce, vice-president of the Underwriters' Laboratories, stated:

"This discovery of the fire-resistive properties in an ordinary-priced partition marks an epoch in the science of construction. It is a new contribution to the art of building that has wider possibilities than we may foresee today. This material has a higher 'time rating' than we or any one familiar with building materials had expected. The whole experiment has proved that there is an unexpectedly good resistance to fire in a type of partition which has not been generally considered fireproof, and now is recognized as more nearly equivalent to strictly fireproof construction than any other building material."

The practical application of these partitions and this type of floor construction in farm structures may be left to the initiative and ingenuity of the designer. Such practical applications at once suggest themselves. For example, the separation of the ground floor of the barn from the haymow above; in very long barns, dividing the haymow into sections by means of light partitions of this type, the separation of dwellings from garages, shops from the implement shed, and furnace or boiler rooms from dwellings, or dividing implement sheds in which expensive machinery is stored, or storage rooms into compartments so that if a fire does break out in one section the loss need not be a total one.

The failure to insist on precautionary measures, which at the time they are suggested seem to be of such slight significance and their need so remote as to evoke indifference and ridicule, at some time may play a very important part in the lives of men. The most unimportant measure may be instrumental in the avoidance of a casualty which might be tragic in its consequences, or the cause of enormous property losses.

New Drainage Districts Perpetuate Hunting and Fishing

A DRAINAGE district near Toolsboro, Iowa, is being developed to perpetuate hunting and fishing within the district. The work is being done in accordance with a resolution adopted by the National Drainage Congress at its last convention in St. Louis, Missouri, favoring the retention of areas unsuited to agriculture in their natural state for recreation purposes.

In the plans for this district the engineer in charge has established a permanent water level through a system of dams and pumping sectors, thus providing excellent ponds for the propagation of fish and feeding grounds for migratory birds.

The development consists of several thousand acres, and the large area between water level and three feet above water level is set aside for swamp, pasture, and the use of birds. Lots have been laid out for club houses and these lots will be leased or sold to various hunting and fishing clubs with the right of entry for members and protection against outsiders.

The levee along the river and the pumping plant have already been built and the various controlling works within the district are under construction. The soil is very fertile and the high land is in productive farms. Many of the lakes are owned by the state of Iowa and furnish excellent hunting and fishing grounds, while the protected areas prevent too great slaughter of birds and fish.

This plan of utilizing the waste land in the drainage district so as to produce a revenue to the landowners and at the same time to provide protected hunting and fishing places seems a happy solution of the tax problem of the owner and the field problem of the sportsman.

Standard Screw Threads Adopted

THE American Engineering Standards Committee has just approved as American Standard a 32-page document, constituting the finished work of the sectional committee on standardization and unification of screw threads, in the field of threads for bolts, machine screws, nuts, and commercially tapped holes. The committee, which has done this work under the joint sponsorship of the American Society of Mechanical Engineers and the Society of Automotive Engineers, was organized in 1920, and includes in its membership many of the most distinguished experts on this important and difficult subject.

The report has been prepared in collaboration and agreement with the National Screw Thread Commission, which includes several members of the sectional committee, and in which the S. A. E. and the A. S. M. E. are the two civilian participating organizations. The present report is based upon the progress report of the Commission.

By the adoption of the report of this committee, screw threads are narrowed down to, and standardized upon, two series—an "American coarse series" for general work, and an "American fine series" for work in which a finer thread is desirable, as with the special alloy steels used extensively in the manufacture of automobiles. The same form of thread is used in both.

The adoption of standard screw threads is perhaps the most important single advance in American industrial standardization, certainly in the mechanical industries, since screw threads are fundamental to design and manufacture in every field, and enter into almost every kind of manufactured product and machine. In shipbuilding, and the manufacture and repair of automobiles and farm implements, in bridge and building construction, and in fact in every one of the great industries on which our mechanical civilization is built up, the standardization of screw threads is a factor of paramount importance.

The coarse-thread series is the present U. S. Standard (or Sellers) supplemented by the A. S. M. E. Standard below one-fourth inch, and the fine-thread series is the S. A. E. Standard supplemented by the A. S. M. E. fine-thread.

Different classes of fit (loose, free, medium and close) are established with corresponding numerical tolerances to provide for unavoidable inaccuracies of workmanship under practical conditions. A standard screw thread nomenclature and also a system of identification symbols for use in correspondence, drawings, and shop practice, are established.

Referring to international standardization, the foreword to the report states: "* * * the sectional committee hopes that further steps may be taken by mutual concessions which result in bringing together the Whitworth (British) and the American systems of threads so as to secure interchangeability in the English-speaking world. The committee also looks forward to the time when, by conferences with the standardization associations of the countries using the metric system, agreements along similar lines for fits and tolerances for metric threads will be brought about."

Research Methods in Agricultural Engineering

Research activities in the agricultural-engineering field are presented under this heading by the Research Committee. Articles dealing purely with the manipulation of research methods and equipment are featured. Members are invited to discuss material presented and offer suggestions on timely topics

Investigation of Farm Sewage Disposal Systems

By R. H. Driftmier

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THERE are various methods whereby the farmhouse, the isolated dwelling, or institution which has no public sewage system within an economic distance may dispose of its wastes in a sanitary manner. The type of disposal system to be adopted will depend largely upon the character of the water supply system in use. Where running water under pressure is not available the excreta may be cared for by means of chemical closets, or some type of sanitary privy which may either be a pail closet or the liquefying tank. The chemical closet is a device, the primary object of which is the chemical disinfection of excreta. The sanitary privy, on the other hand, is a device in which human excreta may be deposited and, pending final disposal, is stored in such a way that there shall be no channel of communication between the excreta and the bodies of human beings. It is thus evident that these methods do not provide for a final or complete disposition of the sewage. Each system merely provides a temporary and reasonably safe storage place for the human wastes, and demands more or less constant and systematic attention on the part of the user if it is to be utilized in a safe and sanitary manner.

Inasmuch as these methods in themselves do not provide for a satisfactory final disposal of the wastes, it would seem advisable to consider more particularly those methods whereby a complete disposal plant may be provided. A disposal plant of this kind should be of such a character that when properly installed it will tend to be, so far as possible, self-operative and will, moreover, require the least possible attention on the part of the user.

The methods wherein running water under pressure can be utilized therefore offer the quickest and safest solutions for sewage disposal. With running water available, sewage treatment may take place in a water-tight cesspool, leaching cesspool, combined tight and leaching cesspool, septic tank of one or more chambers, biolytic tank, or Imhoff tank.

It is a more or less established fact that sewage purification is primarily a biological phenomenon, regardless of the type of system used. The problem of sewage disposal, therefore, readily resolves itself into three main parts: (1) the separation of the solid refuse from the liquid wastes, (2) the satisfactory disposal of the solid matter, and (3) the safe disposal of the liquid wastes.

It is possible to treat sewage to a high degree of purification, but this in itself is not the whole problem of sewage disposal. The most important problem is to get rid of the wastes in such a way as to prevent the transmission of disease and at the same time avoid the creation of a nuisance. Sewage disposal must therefore, first, be safe; second, it must be relatively simple in its operation, and, third, it must be relatively economical in cost. This would indicate that sewage disposal for country homes must be studied under a wide range of conditions before any method for general application can be adopted.

It is essential that investigations be conducted on various known types of systems. By so doing the engineer will have established data and fundamental facts which will go a long way in enabling him to design intelligently a satisfactory rural plant. By an intelligent interpretation of results, obtained from installations under different conditions, adaptations and modifications can be made to fit other known conditions. Thus it is essential that in making a biological study of the sewage the data on all factors in a locality which may have a definite bearing on the successful purification and disposal of the sewage be secured at the same time. The more extensive, systematic, and intelligent the investigations become the more quickly will it be possible to furnish the farmer with disposal works which, when properly installed, will provide safe and satisfactory service.

The field of investigation for farm sewage disposal where running water under pressure is available may be confined to two general classes of conditions, first, where the conditions for sewage disposal are unlimited; and, second, where the conditions for disposal are limited. The first class includes the greater per cent of farm homes and a small per cent of suburban homes and estates. The second class includes the greater per cent of suburban homes and estates, and a very small per cent of farm homes. Agricultural engineers are primarily interested in the first class, and the first investigations should therefore be centered about such rural conditions.

The complete disposal system resolves itself into three main parts: (1) the house sewer, (2) the tank, and (3) the final disposal medium. Very little, if any, investigational work need be done along the lines of the house sewer. Engineering practices are very well established for the selection of pipes and the construction of sewer lines from the house to the disposal works. In the disposal works, however, a great many problems are encountered, and it is the successful solution of these which is of the greatest concern in research work.

Space does not permit an outline of a course of procedure for investigational work that will cover fully all types of systems with their various ramifications made necessary by local conditions. However, the investigator should have in mind primarily the extent to which purification should be carried.

In the first place the investigations may include a study of the physical characteristics of the sewage and effluent as they are affected by volume and distribution of daily flow. The concentration or proportion of sewage matter to water, the amount of flow per person per day, and the composition may be included in this grouping. The problem of composition will undoubtedly overlap into the chemical characteristics.

Secondly, the effects of volume and distribution of flow on the chemical characteristics of the sewage and effluent should be considered. The factors involved in this grouping are quite varied. A fairly complete chemical analysis should include the determinations of the total and suspended solids present, especially that proportion of each made up of organic and inorganic matter; the determina-

tion of nitrogen as ammonia nitrogen, organic nitrogen, nitrite nitrogen, and nitrate nitrogen; the determination of the total oxygen consumed; and, lastly, a determination of the biochemical oxygen demand.

The third part of the investigations should include a study on the effect of volume and distribution of flow on the bacterial characteristics of the sewage, the effluent, and the liquid after it has passed through the final disposal medium.

Since the tank treatments do not purify sewage but serve principally to change the form of the organic compounds, the proper disposal of the septic tank effluent is a matter of very great importance. The effluent as it comes from the septic tank may be treated a number of ways: (1) by means of a subsurface tile system, (2) by means of a filter trench, (3) by means of a sand filter, trickling filter, or straw filter, and (4) by contact beds. The filter trench and the underground tile system seem to offer the most suitable solution for the isolated farm home.

The investigational work should cover all classes of conditions and types of construction both at the tank and at the final disposal system for the effluent, but the fundamental physical, chemical, and biological factors must be studied and understood before proper experimental work can be undertaken. It seems reasonable then to assume that preliminary studies should be made first along these fundamental lines previous to a wide diversity of applications.

A system of disposal suitable for the isolated home may have no practical application in the suburban district. Cities have found that it is desirable to prevent over-septicization of sewage effluents on account of disagreeable odors produced. On the other hand, this may not be a great factor in the country. It is indeed probable that the reduction of sludge volumes are more important than odors from septic tanks.

Direct comparisons between urban and rural disposal systems may be helpful in some respects but of doubtful value in others. The whole problem resolves itself into an intensive study of farm conditions where the farmer must operate and be responsible for his own sanitary system. Many state and some federal publications have been issued on this subject, a partial list of which is appended. Most of these have been prepared from observations of practice rather than research. It is to be hoped that a number of states will take up some phase of such research work which will add to the now limited knowledge on this subject.

It would be impracticable, if not financially impossible, for any one station to undertake such an elaborate project as to include every conceivable construction and condition. It is not at all probable that each investigator will decide on the same design and type of system. It is desirable, however, that similar investigations be carried out at different stations in order that results may be compared.

To summarize the research features entering in a broad general way into a study of farm sewage disposal, it would seem advisable to begin with an analysis and classification of conditions for sewage disposal on the basis that purification of sewage is primarily a biological phenomenon, regardless of the type of system employed. Investigations should the nbe conducted on various systems to establish what may be called certain endpoints by means of chemical determinations of nitrate and nitrite nitrogen, per cent of solids, etc., thus establishing the relative efficiencies of these different systems. A study of the biological effects of these treatments should follow.

With sufficient data gathered in this fashion, one should be able to predict with considerable accuracy the results to be expected under conditions within the range of the investigations and would probably have the general groundwork for a much more intelligent design of rural sewage disposal systems than prevails at present.

Since the biological conditions for a 100 per cent purifying sewage disposal system are not known, it would seem that the problem at this point logically resolves itself into a joint problem for the engineer and the biologist. In short, it would seem t obe the duty of the biologist to give the agricultural engineer a statement as to the exact conditions of temperature, time, nutrients, toxins, pressures, oxygen per cents, and all other factors that enter into complete biological purification. This would result in studying biological decomposition and purification entirely separately from the septic tank in order to establish the exact conditions which must later be met by the engineer in the design of the tank. Intelligent cooperation of this nature would seem to place the responsibility for the different phases of the farm sewage disposal problem on those best fitted for their solution, thus resulting in a saving in time, labor, and money, and logically in the production of the most sound fundamental results.

AUTHOR'S NOTE:—For assistance received in the preparation of this article, acknowledgement is extended to Prof. H. B. Walker, head of the department of agricultural engineering, Kansas State Agricultural College.

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Survey of Agricultural Engineering Progress

A review of current literature on engineering as applied to agriculture prepared monthly by Robert W. Trullinger, Mem. A. S. A. E., specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture

[Agricultural Engineering Studies at the Wisconsin Station]. (Wisconsin Station Bulletin, Madison, 362 (1924), pp. 64-69, figs. 2.) Studies by F. W. Duffee are said to have shown that greater economy results from running silage cutters at a lower speed than that commonly recommended. This is especially true of the larger machine. With smeller machines the capacity is more often the limiting factor, and more corn can be put through them by operating at a higher speed within the usual limit, but with these machines as with the larger ones the efficiency is much greater at lower speeds. There was an extreme fluctuation in proper requirements at the higher speeds. At slower speeds the peak loads did not go nearly so high and the pull was more uniform and steady. The same applied in general to the elevation of silage by blowing.

Studies on the durability of different kinds of tile under various soil conditions by E. R. Jones and O. R. Zeasman, in cooperation with the U. S. D. A. Bureau of Public Roads, are said to have shown that in general comparatively poor concrete tile stand up well in clay subsoils, but only the best show signs of permanence in peat. This deterioration in peat is less marked where dense walls with low absorption are secured by firm packing and selected material in the manufacturing process. Such material and packing seems to be practicable only in the thick walls of the 12-inch tile and the larger sizes.

It is recommended that engineers accepting concrete tile for use in peat soils should insist upon steam curing and absorption less than 7 per cent of the dry weight of the tile and a breaking strength of 1,600 pounds per linear foot for all 30-day old tile up to 16 inches in diameter, with an increase of 100 pounds for each inch in diameter thereafter. A strength two-thirds as great as this is considered permissible for concrete tile laid in a clay subsoil and for shale tile laid in any soil for all tests up to 6 feet. At greater depths the greater strength is required for both shale and concrete tile.

Data on the use of sodotol as a farm blasting material is given.

Cinder Block Efficiency in Pier Tests. (Concrete, Detroit 25 (1924), No. 1, pp. 35, 36, figs 3). Tests of cinder blocks in piers at Columbia University are reported. The results showed that the ultimate strength in compression of these piers varied from 649 to 719 pounds per square inch.

The results of compression tests on individual blocks similar to those used in the experimental piers gave ultimate net strengths varying from 1,305 to 2,080 pounds per square inch. The ratios of the compressive strengths of the masonry piers to those of the individual blocks based on gross cross sectional area varied from 0.547 to 0.758.

Velocity of Detonation of Various Types of Explosives. (Engineering and Contracting, Railways, Chicago 61 (1924), No. 6, pp. 1359, 1360.) Experiments on the effect of confinement upon velocity as affecting the choice and loading of various types of dynamites are briefly reported.

Tests of straight nitroglycerin dynamites showed that 40 per cent low freezing gelatin unconfined and primed simply with a No. 6 cap has a very low velocity. Forty per cent low freezing gelatin unconfined and primed with a 60 per cent straight dynamite primer showed a higher velocity than 40 per cent straight dynamite. The confinement offered by 1.25-inch iron pipe was not sufficient to cause 40 per cent gelatin to detonate at high velocity. When confined under a concrete block, 40 per cent low freezing gelatin had a higher velocity than the corresponding grade of straight dynamite.

Low freezing ammonia dynamites exhibited approximately the same characteristics as the straight dynamites as regards increase in velocity under confinement. Sixty per cent freezing gelatin thus showed a higher velocity than the corresponding grade of either straight or low freezing ammonia dynamite. In fact, the 40 per cent gelatin had a higher velocity in a 5-inch cartridge than either the 60 per cent ammonia or the straight. This is due in part to the higher density of the gelatin, but it is an inherent property of gelatins that their velocities in large diameters or under confinement are higher than the velocities of corresponding grades of other dynamites.

Further tests showed that when a line of cordeau is detonated alongside of gelatin dynamite the gelatin detonates at high velocity. This is taken to indicate that a charge of gelatin dynamite can be placed in a well-drilled hole and fired with high velocity by means of cordeau.

It is pointed out that confinement by water does not produce the same effect on rate of detonation as confinement in rock or earth. Under a depth of 7 feet of water, for instance, all types of dynamite, including gelatin, showed a marker tendency to decrease in velocity as the wave of detonation traveled forward from the priming end of the column.

Tentative Standard Methods of Sampling and Testing Highway Materials. (U. S. Dept. Agr. Bul. 1216 (1924)), pp. 96, pl. 1, figs. 13.) Tentative standard methods of sampling and testing bituminous and nonbituminous highway material, draintile and culvert pipe, and metallic materials adopted by the American Association of State Highway Officials and approved by the Secretary of Agriculture for use in connection with federal-aid road construction are described.

Swedish Water Power and the Farmer. Electrical World, New York 83 (1924), No. 20, pp. 992-996, figs. 14.) General information on the rural use of electricity in Sweden is presented, with particular reference to the financing of distribution systems by local farm cooperative societies. It is stated that 40 per cent of the land under cultivation in Sweden is now within reach of electric transmission lines. Experience has shown, however, that unless all the customers are brought together from the very start and directly interested in the enterprise, rural electrification plans are likely to fail. It has also been found necessary to employ a less expensive type of overhead line construction on rural lines than is used on other lines.

Studies by the Royal Board of Waterfalls have shown that in uniformly settled districts economical distribution is obtained by using an intermediate system of feeder lines as follows: From main high-tension substations, 20,000-volt feeders reach out to rural substations systematically scattered throughout the district, and from these rural substations energy is distributed at 3,000 volts to the individual farms, where it is further stepped down to 220 or 380 volts. In the more densely settled districts 1,500 volts is used on the intermediate lines, and if an out-of-the-way village is to be picked up a 6,000-volt line is employed. Under the method of distribution used, the investment in rural systems in Sweden is said to be about $9 an acre.

Icemaking and Cold Storage Plants in Mexico, Central America, and West Indies. (U. S. Dept. Com., Bur. Foreign and Dom. Com., Trade Inform. Bul. 229 (1924), pp. 11+86.) The results of a questionnaire calling for particulars of ice making and refrigerator installations in these countries are summarized.

Tractive Resistance and Related Characteristics of Roadway Surfaces, T. R. Agg. (Iowa Engineering Experimental Station Bul. Ames 67 (1924), pp. 62, figs. 33.) Studies conducted by the Iowa Engineering Experiment Station in cooperation with the U. S. D. A. Bureau of Public Roads and the Iowa Highway Commission on the tractive resistance of road surfaces are reported.

The results showed that of the several groups of more or less independent resistance to the translation of a vehicle over a road the most significant to the highway engineer is that resulting from the interaction of the tire and roadway surface, including the impact effects on translation set up thereby. These effects, reduced to an equivalent force applied at the axle of the vehicle, constitute the rolling resistance which is expressed in pounds per ton of weight of vehicle.

It was found impractical to measure rolling resistance without including the resistance of still air to the passage of the vehicle. Rolling resistance varies within wide limits with the roughness, degree of rigidity, and physical texture of the roadway surface, the type of tire used, the temperature of the tire and of the roadway surface if the bituminous type, and the gross weight carried by the tires. Within the range of good practice in the use of rubber tires, rolling resistance seemed to vary but little with the size of tire.

The temperature of tires was found to rise slowly when the vehicle is put in operation, but finally reached a temperature at which the heat is dissipated as rapidly as it is generated. The maximum temperature reached will vary with the air temperature as well as with the use. The results in a seasonal variation in rolling resistance, which in the case of solid tires may reach a very material percentage of the total rolling resistance but is less marked in the case of pneumatic tires.

While no fixed relation could be established between the rolling resistance and profile of road surfaces, it was readily shown that for a given vehicle and type of road surface the resistance increases with the roughness. Speed and the suspension system of the vehicle as well as the degree of rigidity of the road surface and the nature of the unevenness all enter into the problem. It was shown quite conclusively that under identical conditions the rolling resistance of solid tires is from 6 to 10 pounds per ton higher than for pneumatic tires. This relation was less readily established on gravel and earth roads than on paved surfaces.

The rolling resistance was much lower on clean, dry, hard surfaces than on surfaces covered with snow, even a thin layer of fairly well compacted snow resulting in a decided increase in the rolling resistance. It was shown conclusively that the rolling resistance of sheet asphalt pavements increases materially with an

increase in temperature and that the rolling resistance of the coarse aggregate type of asphaltic concrete increases somewhat with an increase in temperature.

Studies of relative fuel consumption on different types of road surfaces showed that the best results were obtained on concrete and best gravel roads.

A Possible Solution of the Crankcase Oil Dilution Problem, I. L. Anderson. (Jour. Soc. Automotive Engin., New York 15 (1924), No. 1, pp. 43-46, figs. 6.) A brief discussion is given of the method of ventilating the crankcase as a solution of the crankcase oil dilution problem. The apparatus used is described, and tests under operating conditions are reported.

Much less oil dilution occurred when the crankcase was ventilated, and the gasoline consumption was less. However, more oil was consumed.

Further tests indicated that a large percentage of the extra oil consumption was caused by oil in the form of a fine spray being carried with the air into the carburetor. This oil was caught by the oil trap, utilizing centrifugal force, and was found to be of good quality. Quantitative values seemed to indicate that only part of the oil carried by the air into the explosion chamber was burned, the remaining part serving as a lubricant in the cylinder.

This method of solving the crankcase oil dilution problem requires only an inexpensive apparatus and operates with negligible power.

Is Ammonium Nitrate an Explosive? R. Aufschlager, (trans by H. Schlatter) (Zeitschrift fur da gesamte Schiess—und Sprengstoffwesen, Munich, 18 (1923), No. 11-12, pp. 117-120; trans. in Chemical and Metallurgical Engineering, New York 30 (1924), No. 16, pp. 619-621.) The results of different studies on the explosibility of ammonium nitrate are summarized, in which a velocity of detonation of about 2,500 meters per second was observed. This is taken to indicate the character of ammonium nitrate as a destructive explosive. Ammonium nitrate is insensitive and difficult to detonate and can not be classed with practical blasting explosives, since it propagates detonation only under certain conditions such as its existence in large masses, large diameter, or in trong confinement. On the other hand, even unconfined ammonia nitrate can be detonated with certainty, although with greater difficulty than when confined, provided the initial impulse is sufficiently strong. Since this is true not only for specially prepared ammonium nitrate but also for the raw somewhat moist technical product, blasting must not be resorted to in order to loosen caked heaps of this material, as this could easily result in the explosion of the entire mass.

Impervious Concrete, H. C. Badder. (London: Educational Publishing Company, Ltd.. 1923, pp XX+204, figs. 29.) This book contains information on the selection of aggregates, mixing and depositing of concrete, finishing of exposed surfaces, and the completion of day work joints and expansion and contraction joints in order to secure impervious concrete. Chapters are included which discuss aggregates, sand, proportioning, water, relative consistency, water-cement strength, and inundation sand methods; Portland cement, white Portland cement, alumina cements, electric, cement fondu, etc., and oxychlorid cement; mixing concrete, machinery and plant for mixing concrete, concrete factors, concrete forms, tools in finishing concrete, spouting concrete, and concrete repairs; impervious concrete, impervious joints in concrete, and concrete for chemical work; portable concrete construction units, precast concrete, precast work in France, vibration for precast concrete, coloring cements, and painting concrete; concrete finishing, jointing pipes, cement mortar, and hard, dustless concrete; concrete roads, Bates experimental road, and test concrete road, California. Specifications for concrete directory of testing engineers, a glossary of concrete terms, and tables applicable for concrete work are included.

Study of Flocculation Phenomenon with Microscope, J. R. Baylis. (Engineering News-Record, New York 92 (1924), No. 18, pp 768-769, figs. 4.) Microscopic studies of coagulated matter in filter beds are reported, indicating that floc which filters excellently and that which passes the beds readily show great differences in structure.

It was found that great danger exists in over coagulation in that it produces an easily broken floc which will readily pass rapid sand filter beds. Suspended matter adds toughness to the floc. It is concluded that there should be a rapid mixing of the alum with the water immediately after application.

The Mechanism of Lubrication. III. The Effect of Oiliness on the Behavior of Journal Bearings, D. P. Barnard, H. M. Myers, and H. O. Forest. (Industrial and Engineering Chemistry, Washington, D. C. 16 (1924), No. 4, pp. 347-350, figs. 8.) In a third contribution from the Massachusetts Institute of Technology, the results of a series of experiments to determine the effect of oiliness of the lubricant on the carrying power of a conventional type of journal bearing are reported.

It is shown that the carrying power is somewhat greater when oiliness, as measured by the coefficient of static friction, is increased. The increase is small for variations among commercially practicable lubricants.

The position of the transition point from stable to unstable lubrication for a complete cylindrical bearing was found to be altered by variations in the oiliness of the lubricant. The transition point occurs at a lower value of the modulus znp when oiliness as indicated by the coefficient of static friction is increased. In this modulus z is the viscosity of the lubricant, n is the speed of rotation of the journal, and p is the nominal pressure on the bearing in pounds per square inch.

The variation of the transition point from stable to unstable lubrication to be expected with commercial lubricants was found to be not over ten per cent. While it is possible to detect changes in oiliness by means of a journal testing machine, the experimental difficulties are considered to be such as to preclude the use of such a machine for the measurement of this property. It is believed that the coefficient of static friction offers the most convenient single measurement of oiliness.

It was further found that the position of the transition point is strongly affected by variations in clearance.

Sugar Dust Explosions [trans. title], P. Beyersdorfer. (Zeitschrift des Vereins der Deutschen Zucker-Industrie, Berlin 1922, No. 789, II, pp. 475-533, figs.9.) A survey of dust explosions in sugar refineries in Germany during the past 30 years is given, and studies extending over two years on the factors governing such explosions are reported.

It was found that the cause of sugar dust explosions can be either thermal or electrical. The combustion temperature of sugar dust in air was found to be 410+1 degree Centigrade (770 degrees Fahrenheit), and in oxygen about 371 degrees. Ozone in small quantities decreased the temperature of combustion of sugar dust in air about 3 degrees and in oxygen about 4 degrees. The temperature of combustion was found to depend upon the oxygen content of the gases in which was ignited and on the heat conductivity of the relatively inert gases which accompany the oxygen. Carbon dioxid had a greater extinguishing influence than nitrogen.

A graphic representation of the dependence of the combustion temperature of sugar dust upon the oxygen content of a mixture of oxygen and nitrogen showed that the curve proceeded asymptotically to the temperature axis. A parallel to the temperature axis through a point corresponding to 9 per cent of oxygen in the mixture represented the division of combustion into plain burning and explosion.

The explosion of sugar dust by heat was found to end in a gas explosion, and to consist of a gasification phase and an oxidation phase. The upper limits for a dust explosion in air corresponded to a mixture of 13.5 kilograms of dust per cubic meter of air and the lower limits to 17.5 grams per cubic meter.

Sugar dust was found to charge itself positively on passage through the air. A tension of more than 10,000 volts was caused by whirling agitation of sugar dust in air. Electrically charged sugar dust will discharge when agitated in a gas. Sugar dust can therefore be exploded in a variable field. This electrical explosion has three phases. The first is the formation of ozone and nitrate, the second is the reaction of these substances with the finest sugar particles, and the third is the explosion proper resulting from the occurrence of this reaction in a variable field. Sugar dust forms a so-called aerosol with air. A sudden bringing about of the isoelectric point produces a flash which ignites the dust cloud. The violence of the explosion is attributed to the absorption of oxygen by the dust.

The practical significance of these results is discussed. The opinion is expressed that the surest method of preventing sugar dust explosions is to fill the pulverizing machine with relatively inert gases.

Sprayers and Spray Equipment for Orchard and Garden, M. B. Cummings. (Vt. Agr. Col. Ext. Circ. 30 (1924), pp. 12, figs. 11.) Illustrative and descriptive suggestions relating to the purchase and use of sprayers and spraying equipment for orchard and garden are presented.

Concrete Fence Posts, J. B. Davidson. (Iowa Station Bulletin. Ames, 219 (1924), pp. 19-44, figs. 30.) The results of studies begun in 1914 on the practicability, durability, construction, and cost of concrete fence posts are reported. Over 700 posts were tested, of which 48 were reserved for laboratory tests and the remainder used in field tests.

The results showed that very satisfactory fence posts may be made of concrete. The life of a first class concrete post was found to be very long, little deterioration being evident after a period of nine years. A post with approximately square or round cross section was the strongest for the material used. A dense or rich concrete was found to be necessary to protect the steel reinforcement from corrosion. The minimum amount of cement was needed when sufficient coarse graded aggregate was used. Four 0.25-inch square twisted reinforcing bars or their equal were needed for the utilization of the full strength of the concrete in the common sizes and types of posts in general use.

It was necessary to place the steel reinforcement at least 0.75 inch below the surface of the concrete to secure maximum strength with adequate protection of the steel from corrosion. It is noted that the opportunity for failure is large with poor workmanship or low quality materials. A large amount of data on methods for construction are included.

Dynamometer Tests at Potchefstroom, W. S. H. Cleghorne, (Union of South Africa Department of Agriculture Journal, Pretoria, 8 (1924), No. 3, pp. 340-344, fig. 1.) Three sets of dynamometer tests of plowing on different soils with different types and sizes of plows, including disk and mold board plows, are reported an ddiscussed.

Outstanding results of the tests were that the mold board plows showed a lighter draft throughout than the disk plows when both were used at approximately the same depth. In one set of tests the draft of the mold board plow per square inch of furrow slice was 28 per cent less than that of the disk plow. However, the disk plow pulverized the ground much better than did the mold board plow.

A. S. A. E. and Related Engineering Activities

Meeting of Farm Power and Machinery Division

THE preparation of the program for the meeting of the Farm Power and Machinery Division of the American Society of Agricultural Engineers to be held in Chicago early in December is well under way. F. A. Wirt, chairman of the division, and his associates on the committee arranging the program have been working on it a month or more, and the tentative program that has been prepared gives promise that it will be of special interest to all who are connected with the engineering and designing end of the farm-equipment industry.

This meeting is the first real attempt to plan a program that has a particular appeal to designers and engineers connected with farm-equipment manufacturing concerns. It is believed that much benefit will be derived, by individual engineers as well as the farm-equipment industry as a whole, from a meeting designed to get these men together for the purpose of getting acquainted and discussing problems of common interest to them all. The automotive industry is a typical example of what it has meant to the engineers in that industry to get together frequently at meetings arranged for their particular benefit. A tremendous amount of good has resulted to the individuals who attended and the industry as a whole from such meetings, and the rapid development that has taken place in that industry has been due to a large extent to the inspiration and help which its engineers receive by frequent contact with their fellows in the industry.

There is no reason why the same results could not be had in the farm-equipment industry through a more frequent contact of its engineers and designers with each other. The meeting of the A. S. A. E. Farm Power and Machinery Division to be held in December is the beginning of an effort in that direction.

The tentative program includes reports on 1924 tests of silo fillers as conducted at two of the state agricultural colleges. The presentation of these reports will be followed by discussions of the engineers conducting them and also engineers connected with various manufacturers of silo fillers.

One of the big problems in the wheat-growing regions of the country, particularly in the spring wheat area, has been the heavy losses to farmers due to the increasing percentage of dockage. During the past two years the U. S. Department of Agriculture has been conducting extensive investigations along these lines and giving encouragement to ways and means of reducing the tremendous losses from this source. Grain cleaners have been developed for removing dockage from the wheat either at the thresher or at the country elevator, and a technical presentation of the design, construction, and use of these cleaners will be a feature of the meeting of the Farm Power and Machinery Division. In connection with this engineers responsible for the design of grain threshing machinery in a number of manufacturing plants are being asked to discuss the subject.

The purely technical and engineering phases of the design of soil handling machinery, which will feature the real fundamentals of the art, will be presented by several engineers connected with manufacturers of soil tillage equipment.

One of the outstanding engineering developments in the farm-equipment industry during the past few years has been that of the combined harvester and thresher, the field of which has lately extended considerably east of the Rocky Mountains. Moreover, the field of this machine has increased greatly with the development of the smaller combine. The engineering development and possibilities of the combine will be discussed by various engineers in the industry who have been responsible for its development and the progress made.

The rating of farm tractors is always a subject that brings forth lively discussion. Advanced ideas on the art will be given by several leading engineers in the industry.

One of the things that is causing considerable concern on the part of agricultural leaders of this country is the menace of foreign agricultural competition. In the case of the farm-equipment manufacturer his exports have been doubled and his domestic sales have been cut in two. It is just as important to the farm-equipment manufacturer as it is to the farmer, that the latter continue to hold the place he has always occupied in supplying the world's market for foodstuffs, but the situation that the farmer is up against today is a serious one, and the solution of the problem seems to lie largely through the more extensive and more efficient use of mechanical power and labor-saving equipment. The engineering phases of this problem will be discussed at some length at the Farm Power and Machinery Division meeting.

The joint activities of the A. S. A. E. Committee on Cooperative Relations and a similar committee from the National Association of Farm Equipment Manufacturers will also be presented at this meeting. In addition there will be reports of other committees of the Farm Power and Machinery Division.

Testing Apparatus for Agricultural Engineering Research

THROUGH the courtesy of the General Motors Research Corporation three pieces of experimental testing apparatus have been placed at the disposal of the American Society of Agricultural Engineers to be allocated at state or federal institutions engaged in agricultural engineering research, which have a bona fide use for them.

The apparatus consists of (1) a Watson hydraulic dynamometer arranged for recording draft up to 6,000 pounds, which can be placed between the motive power and implements furnishing an autographic record of draft, time, and distance; (2) a Hyatt recording hydraulic dynamometer, the recording element of which is carried by the observer and the pressure element mounted between the tractor or team and the implement being tested; and (3) small dynamometer car arranged to accommodate the Hyatt dynamometer in case tests at constant load are desired, which is equipped with friction brake capable of absorbing loads up to ten and twelve horsepower at ordinary tractor operating speed.

The Council of the Society has accepted the apparatus in accordance with a plan agreed upon by the Council. The plan is that state and federal research agencies engaged in agricultural-engineering research who desire the use of any of this apparatus should apply either to the Secretary of the Society or the chairman of the Research Committee. Such application should state in detail the use to which the apparatus will be put and for how long they will be used. The Research Committee will pass on the merits of the application and if the work proposed justifies such use the machines will be allocated accordingly. Requests for the use of the apparatus will be considered in the order they are received and will be arranged in the order of their merit.

Institutions using this apparatus will be required to pay all shipping charges to and from the General Motors Research Corporation at Dayton, Ohio. Unless especially arranged for with the Research Committee, each institution

using the apparatus will ship it back to the General Motors Research Corporation so that it may be inspected and repaired if necessary before being shipped to any other institution. The purpose of this is to hold each institution responsible for the condition of the apparatus after it has been used, with the exception of course of reasonable wear and tear. Institutions using the apparatus will retain them only so long as they have a legitimate use for them.

This offer of the General Motors Research Corporation presents a most excellent opportunity for institutions conducting research, which involve the recording of draft tests, to secure the use of high-grade apparatus which might otherwise be unavailable to them except at considerable expense. It is considered especially desirable that state colleges and experiment stations doing such work arrange their program so as to take advantage of this offer. The only expense to the institution will be shipping charges to and from the plant of the General Motors Research Corporation, including preparation for shipping and any breakage or unnecessary depreciation which occurs during use.

A. E. C. Board Meeting

A MEETING of the Administrative Board of the American Engineernig Council has been called for October 17 and 18. This meeting will be held at the headquarters of the Western Society of Engineers in Chicago.

A Timely Recommendation

THE Interstate Commerce Commission, in response to a resolution passed by the Council of the American Society of Agricultural Engineers, protesting against the use of wooden sleeping cars between steel ones, published in the September issue of AGRICULTURAL ENGINEERING, has replied to the Secretary of the Society, advising that while there is no law at the present time prohibiting the use of wooden sleeping cars, the Commission has recommended to Congress that the use in passenger trains of wooden sleeping cars between or in front of steel cars be prohibited.

Personals

R. B. Gray, formerly professor of agricultural engineering at the University of Idaho, recently resigned to accept the position of instructor in automobile construction and repair and farm mechanics at the Gridley Union High School, Gridley, California.

Frank P. Hanson, extension specialist in farm mechanics, is joint author with L. E. Card, chief in poultry husbandry of the University of Illinois, of a new bulletin (Circular No. 291) entitled "A Colony Brooder House That Starts Chicks Right," just issued by the Illinois Agricultural Experiment Station.

E. W. Lehmann, chief in farm mechanics, is joint author with E. T. Robbins, assistant professor of livestock extension, of a new bulletin (Circular No. 283) entitled "Hitching Horses to Get the Most Work Done," just issued by the Illinois Agricultural Experiment Station.

E. W. Lehmann, professor of farm mechanics, and **F. P. Hanson,** extension specialist in farm mechanics, at the University of Illinois, are joint authors of a new bulletin, entitled "Saving Soil by Use of Mangum Terraces" (Circular No. 290) recently issued by the University of Illinois. It deals with terracing as a method of preventing erosion and the construction and maintenance of the Mangum terrace.

C. S. Whitnah, research engineer of the King Ventilating Company, announces the arrival of an agricultural engineer that tips the scales at 7½ pounds. He will be enrolled as Donald Scott Whitnah.

W. L. Zink has resigned as a member of the staff of the division of agricultural engineering, University of California, to accept a position with the Hind Y Compania, Tapachula, Chiapas, Mexico, as engineer and assistant manager of their Mexican coffee plantations.

New A. S. A. E. Members

Edward Barr, executive director, Northwest Dairy Exposition Committee, 884 Linwood Place, St. Paul, Minnesota.

G. Santos Y. Ciocon, in charge of agricultural engineering investigations, Bureau of Agriculture, Manila, Philippine Islands.

Stanley W. Crosby, research associate in soil technology, University of California, 86 Eucalyptus Road, Berkeley, California.

H. M. Davis, director Nebraska Committee on Public Utility Information, 360 Fraternity Building, Lincoln, Nebraska.

Dudley F. Holtman, construction engineer, National Lumber Manufacturers Association, Transportation Building, Washington, D. C.

Ching Po Sun, department of agricultural engineering, University Farm, St. Paul, Minnesota.

TRANSFER OF GRADE

James Arthur Muncey, 326 West 23rd Street, Houston, Texas. (From Student to Junior Member.)

Applicants for Membership

The following is a list of applicants for membership received since the publication of the September issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send pertinent information relative to applicants for the consideration of the Council prior to election.

TRANSFER OF GRADE

Hobart Beresford, division of agricultural engineering, University of Idaho, Moscow, Idaho. (From Student to Junior Member.)

Percival B. Potter, department of agricultural engineering, Ohio State University, Columbus, Ohio. (From Junior Member to Member.)

Benton M. Stahl, department of agricultural engineering, Ohio State University, Columbus, Ohio. (From Student to Associate Member.)

A. S. A. E. Employment Service

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of Agricultural Engineering. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER, 1923 graduate of Kansas State Agricultural College in agricultural engineering, desires to make a change. Work along engineering lines is preferred. Address M. S. Cook, 5406 Ferdinand Street, Chicago, Illinois. MA-121.

AGRICULTURAL ENGINEER with experience on large farms with all kinds of machinery and equipment wants position with manufacturer of farm equipment. MA-122.

AGRICULTURAL ENGINEER wants position with contractors doing work in farmstead planning and building. MA-123.

AGRICULTURAL ENGINEER open for position as sales engineer, salesman, advertising writer, or agricultural propagandist. Past experience with large agricultural firms. MA-124.

Positions Open

AGRICULTURAL ENGINEER to handle farm machinery, farm power, and related lines of work needed to fill vacancy in the department of agricultural engineering at the University of Idaho, Moscow. Man selected will have the major portion of his time taken up with teaching but will have some time and opportunities for research work. Address E. J. Iddings, dean and director, College of Agriculture.

AGRICULTURAL ENGINEER equipped with good training and experience in agricultural engineering, preferably familiar with New England agriculture, is wanted by state agricultural experiment station in one of the New England states, to take charge of experimental work on rural electrification projects. Write the Secretary of the American Society of Agricultural Engineers.